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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

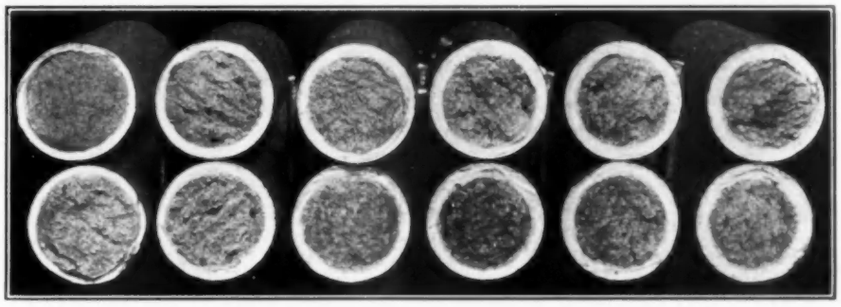
ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY.

Vol. 31. 505 PEARL STREET, NEW YORK. No. 10

Index to Advertisers and Classified Index Following Reading Matter.

CASE HARDENING

A New Process



4 Hours. 8 Hours. 10 Hours. 12 Hours. 14 Hours. 16 Hours.
Time for Carbonizing.

Cost Of Carbonizing Cut In Two

As Compared With Old Methods

See Articles In AMERICAN MACHINIST, *February 13th and 20th, 1908*

It Will Pay You To Look Into It

To Have Your Work Done, Address

American Metal Treatment Co., Elizabeth, N. J.

To Acquire Complete Outfits, Address

American Gas Furnace Company,

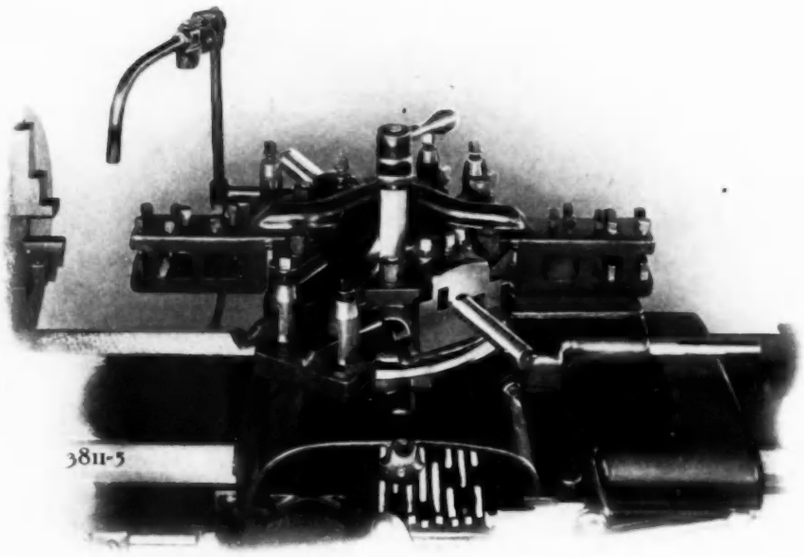
24 John Street, New York.

2½x26 Inch Open

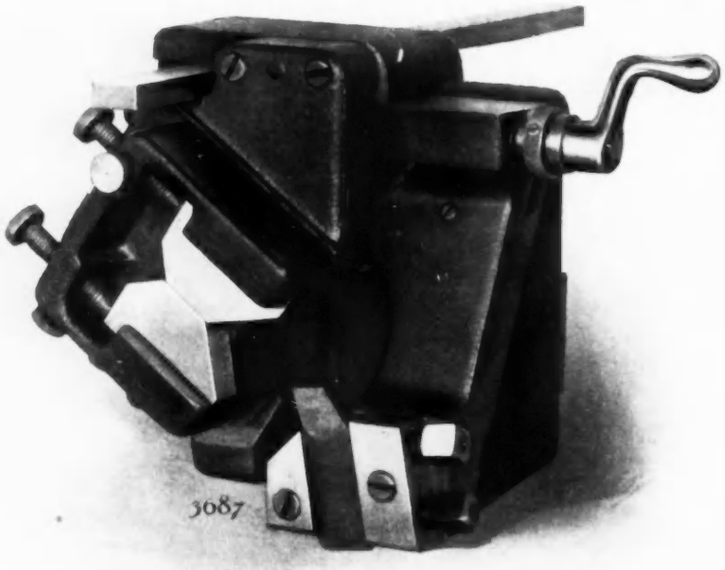
With Cross Sliding Turret for

A New Tool Holder

for heavy chucking work. We show illustration of this new tool holder which permits the use of several tools at one time. It is designed for cast iron work and other heavy chucking jobs.



Tool Holder for Heavy Chucking Work.



Taper Turning Tool.

The Taper Turning Tool shown turns tapers either with small or large end towards the chuck. Jaws move automatically with correct relation to cutting tool. May be used with both leading and following back rests.

Tapers produced with this tool are superior to similar work done on an engine lathe with taper attachment.

Write for catalog "The Open Turret Lathe," showing tools, samples of bar and chucking work, etc.

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Describe your work to us and we will prescribe the proper machine to do it most profitably.

We are builders of Improved Heading- and Rivet-Making machines with open and solid dies, and with single, double or multiple stroke; Automatic machines for making cold pressed, chamfered and trimmed nuts, threading machines, etc.

Mention American Machinist

Solid Die Double Stroke Rivet Machine No. 1.

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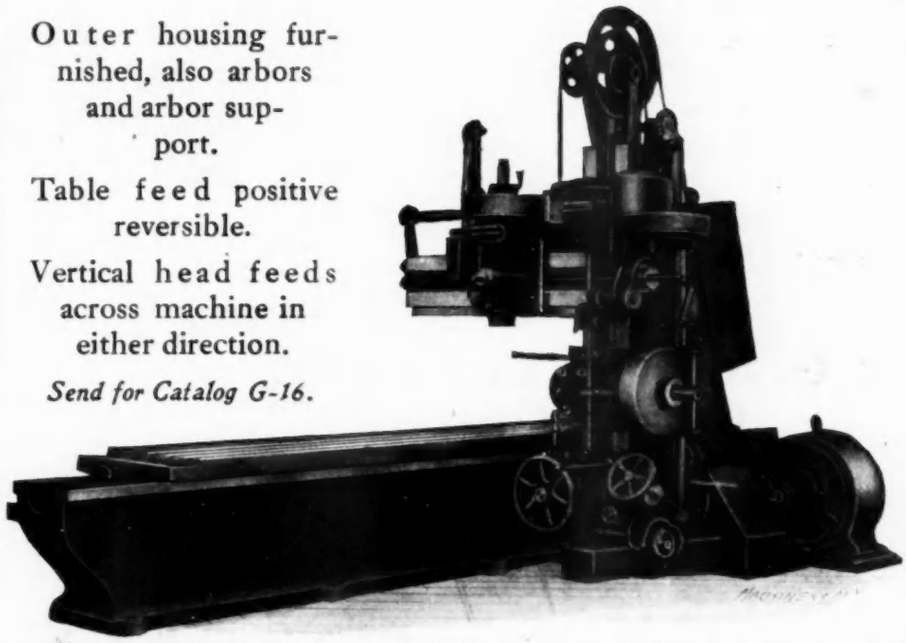
UNIVERSALITY

Outer housing furnished, also arbors and arbor support.

Table feed positive reversible.

Vertical head feeds across machine in either direction.

Send for Catalog G-16.



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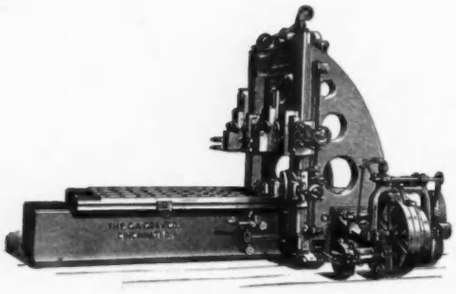
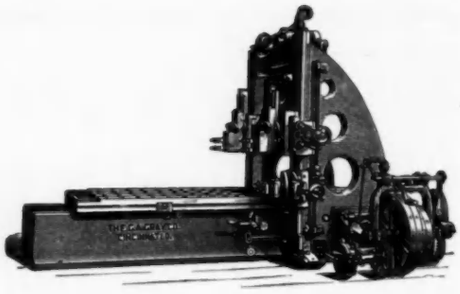
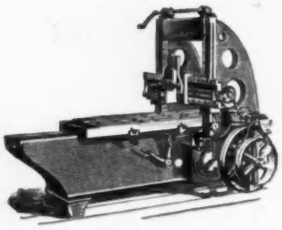
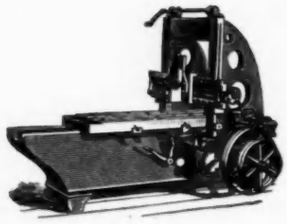




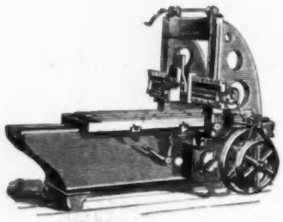
Why he copied Gray Planers.



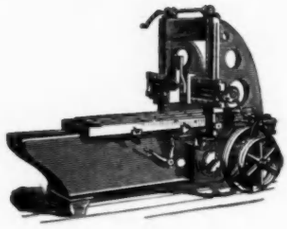
Our American copyists are not as candid as one of our German competitors, from whose catalogue we quote, in translation, as follows:—



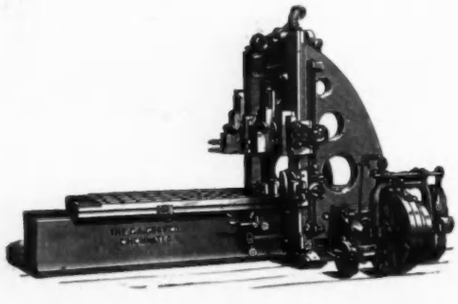
"Of all the planing machines which have been put on the market during the past few years, of German as well as of American construction, the Gray planers surpass all other makes in durability, accuracy, excellence of output and convenience of handling.

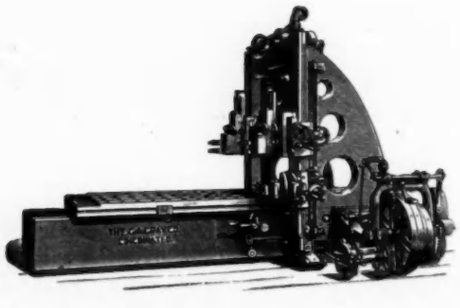


"Our planers embody not only Gray's general design, which is being frequently copied by cheaper manufacturers, but particularly also the various mechanical features, all of which have been proved excellent, thus insuring a smooth, quiet motion, perfectly gentle reverse and independent feeds."



The G. A. Gray Company,
Cincinnati, Ohio.





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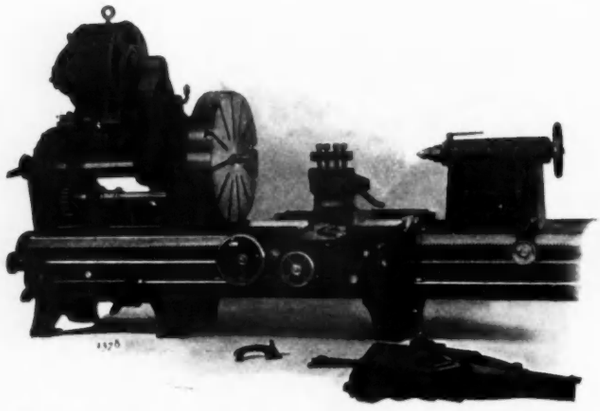
Machine Tools of

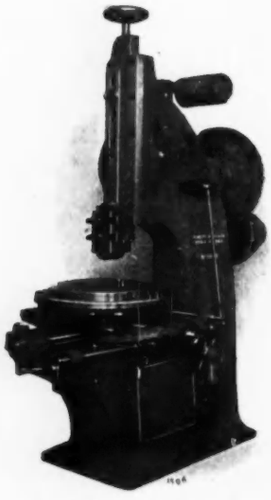
From the Little Bench Lathe

Electric Cranes
2 to 200 tons
capacity.

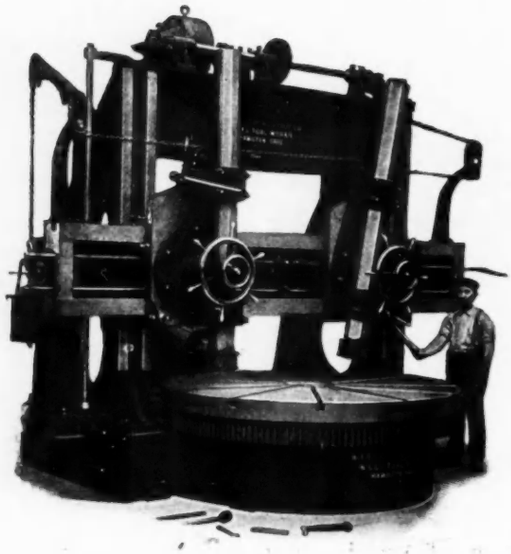


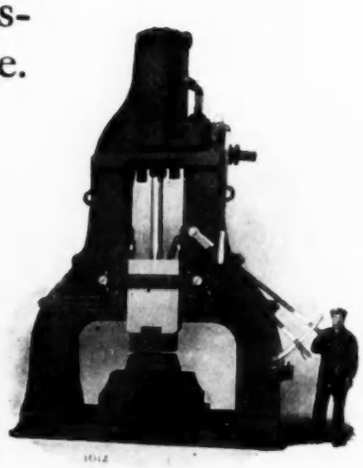
Hydraulic Railway and Boiler Shop Machinery.

All sizes of Lathes from the little Bench Lathe to the massive 125" Crank Shaft Lathe.



Slotting
Machines
6 to 68 inch
stroke.





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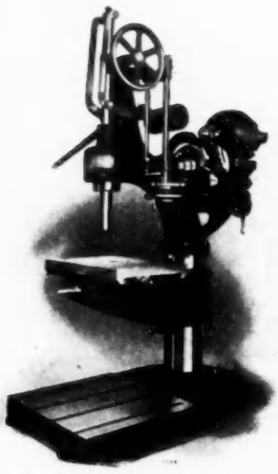
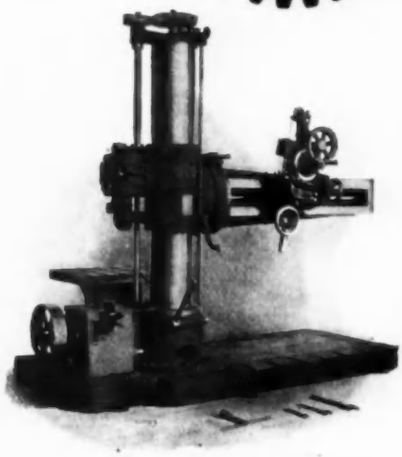
Every Description

to the Gigantic 14-foot Planer



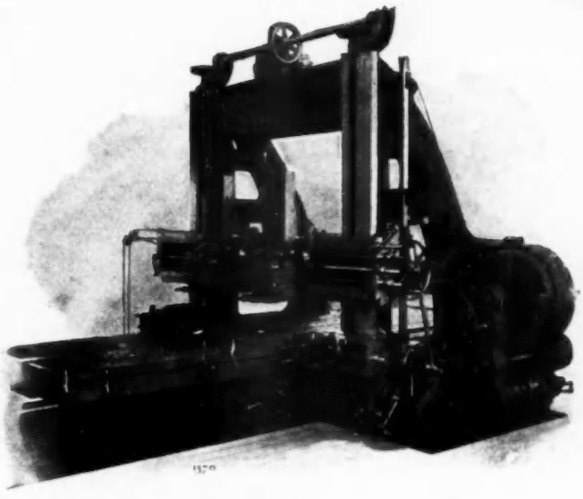
Vertical Drills up to 60"

We install complete machine tool and crane equipment for machine shops.



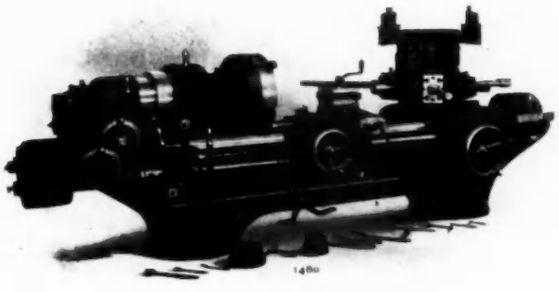
Radial Drills, 3½ to 10 foot arms.

Standard small tools of the machine industry.

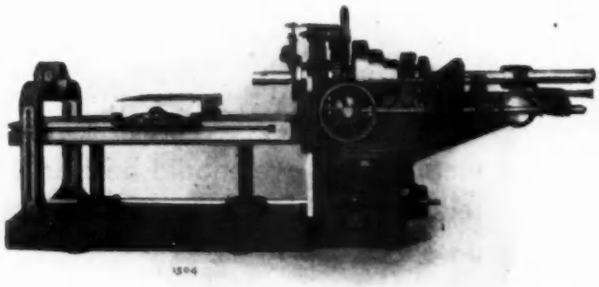


Planers, 17 in. to 14 ft. between houstings.

Catalogues and full information on any tool sent on request.



Pond Rigid Turret Lathe. Two Sizes.



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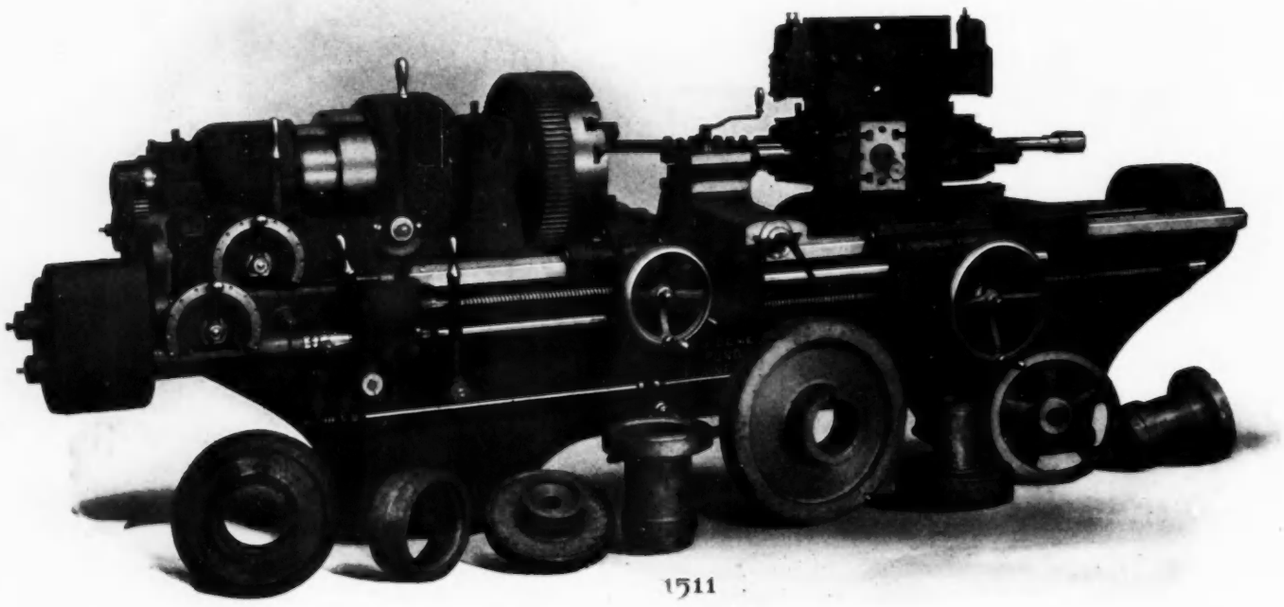
POND RIGID TURRET LATHE



28-Inch Pond Rigid Turret Lathe With Tool Equipment

Various types of work on which the machine can be used to advantage are shown in front.

Have you a little spare time? If so, wouldn't it pay to look into your chucking work? We can save you 40 to 70 per cent. over engine lathe methods and we should be glad to send a man to look over your work and tell you exactly what saving we can guarantee. It will place you under no obligation to us.

Catalog and full information on request.

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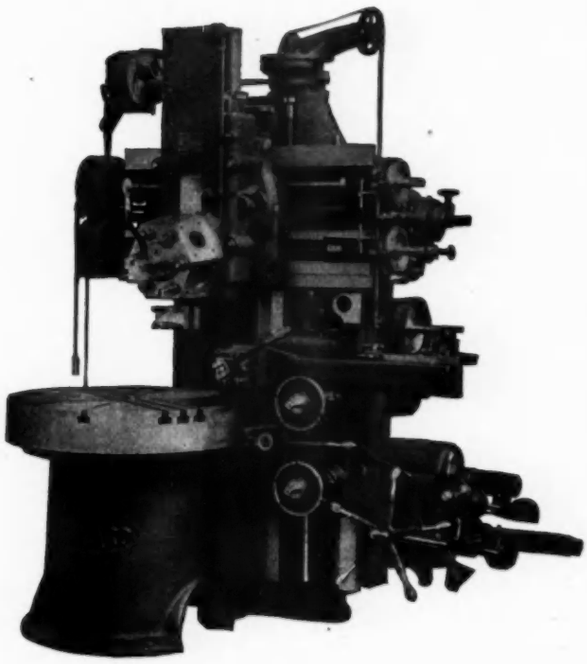
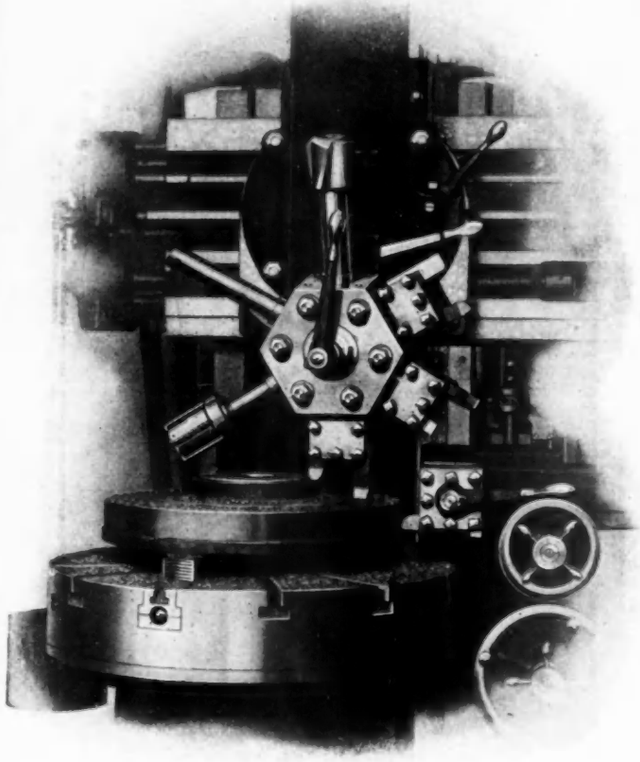
BULLARD

Vertical Turret Lathe





36-INCH VERTICAL TURRET LATHE
Machining a Gear Blank

"To Cut Costs, Cut Time Between Cuts"

The great saving in time and labor made by this lathe is shown in the cut. Several tools are cutting at the same time and all the tools needed for a series of cuts are in readiness in the crosshead turret or the side head. This feature is one of the many that gives the Vertical Turret Lathe its wonderful efficiency, accuracy and speed on all manner of face plate work. It is a modern tool for modern shops.

Ask For Catalog 30.

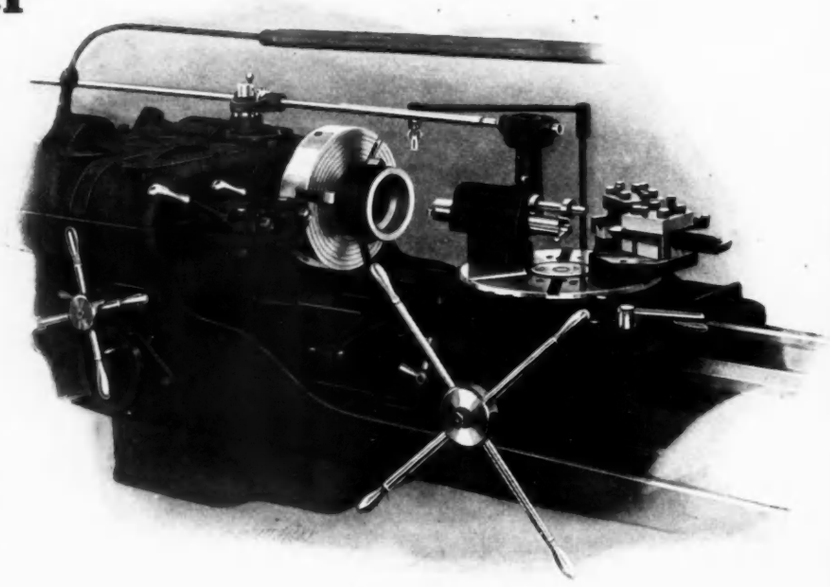
The Bullard Machine Tool Co. BRIDGEPORT, CONN., U.S.A.

AGENTS—Marshall & Huschart Machinery Co., Chicago, Ill. The Motch & Merryweather Machinery Co., Cleveland, O. Chas. G. Smith Co., Pittsburg, Pa. C. H. Wood Co., Syracuse, N. Y. Pacific Tool & Supply Co., 556 Howard Street, San Francisco, Cal. Williams & Wilson, Montreal, P. Q. Chas. Churchill & Co., Ltd., London, E. C., England. Fenwick Freres & Co., Paris, France. Heinrich Dreyer, Berlin, Germany. Landre & Glinderman, Amsterdam, Holland.

The Shop Without A "Flat Turret" Lathe Is In Danger

of being distanced in the modern race of competition where lowest cost of production is entered. "Flat Turret" users are getting an accurate, uniform product of duplicate work at a low cost that means highest profits.

Among the many important exclusive features, the Automatic Screw Chasing Tool shown here is worth your attention. Turn to pages 12 and 13 for further details.



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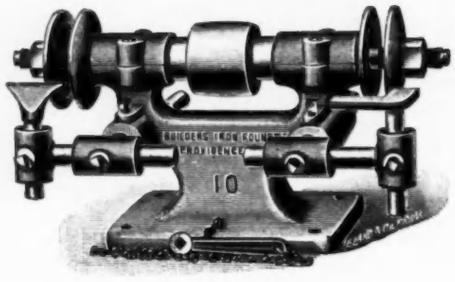
G. & H. BARNETT CO., Phila., Pa.

FOR ALL CLASSES OF LIGHT GRINDING



THIS 10" Grinders Head has unusually large self-oiled bearings placed as near the wheel as practicable—this results in the lowest possible vibration, insures easy running and makes possible the highest speed.

Our Catalog sent upon request.

Builders Iron Foundry,

PROVIDENCE, R. I.

The Regeneration of the Old Shop

The Way in Which a New Management Abandoned Old Methods and Specialized in the Manufacture of Wood-working Machinery

EDITORIAL CORRESPONDENCE

Those who are familiar with old shops, either by personal contact or from observation in late years, will agree that very few shops which date back to the middle of the last century, have thrown off the old and taken on the new as in the case shown herewith.

The S. A. Woods Machine Company, of Boston, dates back very nearly to 1850 and in common with all shops at that time was engaged in building up a "line" of tools of wood-working machinery in their case. This was done so successfully that, when the management fell on the shoulders of Frank F. Woods a few years ago, they had a line of over 100 different machines which were built in varying quantities.

The firm was well known and had a good reputation but Mr. Woods found that the net returns were not satisfactory for the business done and he began to look for reasons. Then followed many visits to various shops which had the result of impressing him with the advantages of specialization in building machines as well as in other lines. Then Mr. Woods showed the courage of his conviction by deliberately cutting down his "line" from over one hundred machines to three. It took nerve but it won out and the results have been satisfactory.

This was only the beginning for the specializing must be carried into the details of manufacturing as well as the numbers of machines built. So the tools for different operations were grouped together into departments. Drilling was systematized, all drills moved to one floor of the shop and placed in charge of a foreman who knew how to handle drills to the best advantage. Other tools were grouped in the same way. Milling machines, lathes, gear cutters, etc., each have their department and each one in charge of a specialist — in fact specialists and specializing are the keynote of the new order of things in the shop.

FIG. 1. THE TOOL ROOM

FIG. 2. A RACK OF JIGS

Uniformity in Tools

After grouping the tools it was found that certain machines were liked better than others and after trying out the makes they had, they decided on one and bought enough for the department, turning the others over to a second-hand dealer. This is why we find practically all tools of a certain make, drills, vertical milling machines, etc. They draw no comparisons, but say they have found machines adapted best for their line of work and believe in having them uniform. This also took nerve as it pulls pretty strongly on the pocket book nerve to discard a lot of good tools so as to have the rest uniform, and this is another point that makes the change all the more remarkable.

The photographs which follow will show that, except for the building itself, the plant can be called modern without in any way straining the truth to the elastic limit, and it is both interesting and encouraging to note some of the results of the change. Instead of distributing the brains and energy of the concern over 100 different machines, they are concentrated on three and as a result these have been improved, both in design and in construction more than was deemed possible four years ago. This extends to the selection of material as well and we now find them using hardened steel pinions where the duty is severe, which is a marked change from wood-working machinery construction, of even a very short time ago.

With this as an introduction to show why the changes have been made and also what obstacles in the way of precedent and structural difficulties had to be overcome, we can better appreciate what has been accomplished. It is also interesting to learn that the net results from the business end have been satisfactory.

The Tool-room System

The tool room may be a good place to start, as this is usually the weakness of

an old plant and was in this case. It has been enlarged to several times its former size, provided with tool racks, with electric lights, and with annunciator and check systems which help to keep the men at work. Bins and boxes for bolts, screws, etc., are of steel, as shown, and are much more extensive than might be imagined from the picture.

The checking system is very similar to many other shops, the men leaving brass checks for tools taken. In addition to this, however, the storekeeper, for the tools are in his charge, has a card index which he is just consulting and which tells him where every man is at work. If he finds that a reamer is out and check No. 731 in its place, he looks up his index and finds that No. 731 is Sam Jones and that he works under foreman Smith. In this way he locates the tool and sends for it if he finds it has been out too long.

The square box-like rack in front of him is the rack for waste checks, each man being allowed two checks a week, each check calling for ¼ pound of waste. There is a slot in the box at the top, over the drawer, and when Jones comes for waste the storekeeper takes one of his waste checks off the rack and drops it in the slot, so that it falls into the drawer. The rack shows at a glance whether a man has had one batch of waste or two or none at all.

Auxiliary Tool Racks

The annunciator is connected to tool stations or departments in different parts of the shop. Each department has a rack like one of those shown, containing the general tools likely to be needed, such as standard drills and reamers. Should additional tools be required the foreman sees or is notified in advance, calls the boy from the tool room to his station and sends down the order to the storekeeper for the tools needed. The men stay in their departments attending to business.

Just to give an idea of the extent to which duplication of work has been carried, and which would have been practically out of the question with the large line they formerly made, one of the jig racks is shown in Fig. 2. This rack has a metal frame with wooden shelves, and carries a check board of its own so that jigs can be charged to a man the same as a tool. The paper tag carries the number of the jig, and if for any reason it is in the tool room for repair or alteration, a brass check with the letter *K* hung on its pin, shows just where it is.

One of the features of this shop is the grouping of tools of similar kinds so as to have all work of one kind in charge of a foreman who is thoroughly familiar

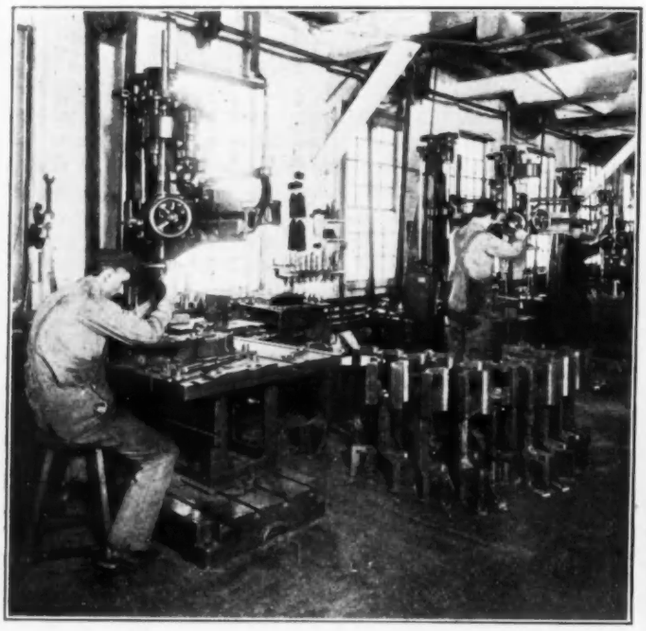


FIG. 3. A LINE OF RADIALS IN THE DRILLING DEPARTMENT

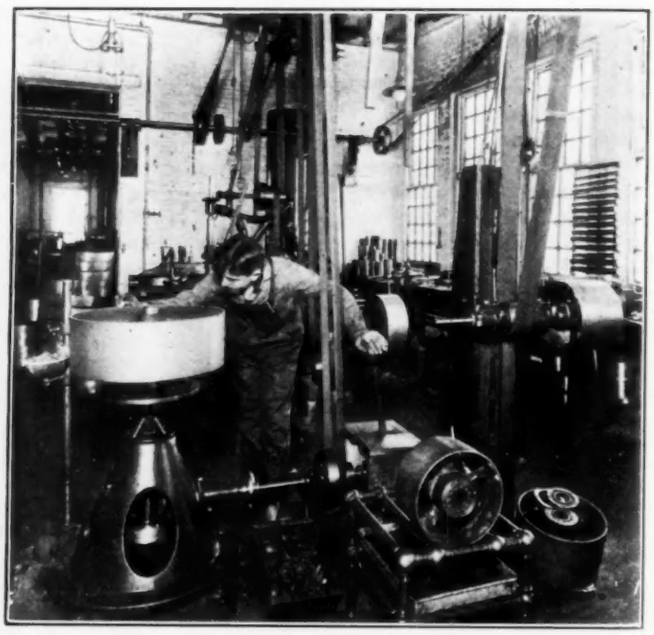


FIG. 4. BALANCING PULLEY FOR STANDING AND RUNNING BALANCE

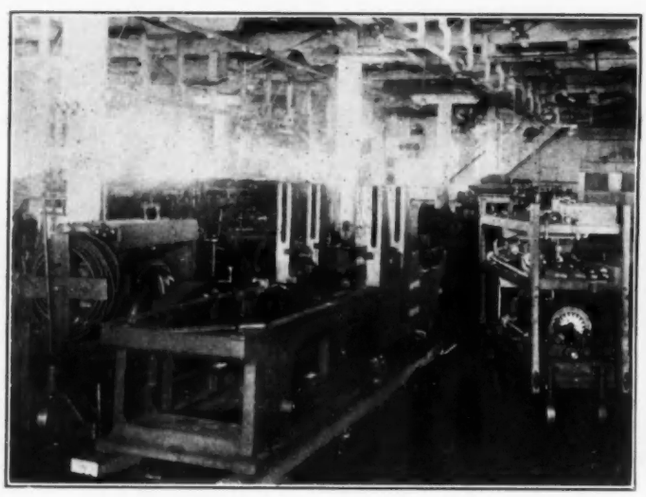


FIG. 5. ASSEMBLING TRUCK AND PORTABLE MOTOR

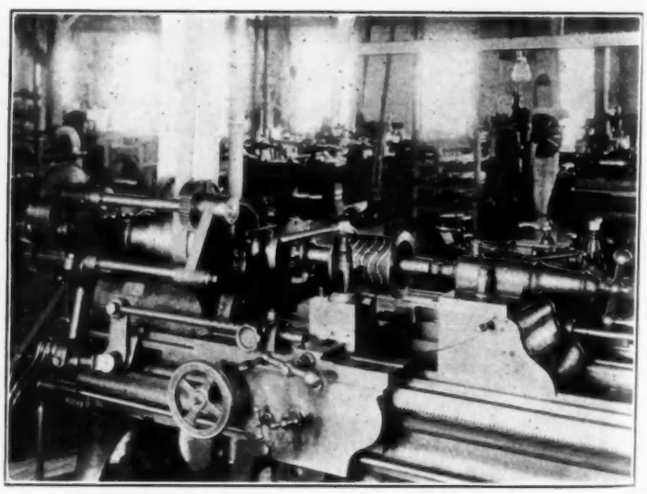


FIG. 6. TURNING AIR-GOVERNING PULLEYS

with it, and Fig. 3 gives an idea of the drilling department with its row of Prentice radials, just to show how it has been done. This is only a part of the department, but it shows the lighting, the shop construction and the general arrangement.

Balancing and Testing Pulleys

The balancing of pulleys and rapidly revolving parts is of great importance in wood-working machinery but might well receive more attention than it does in high-speed machinery of all kinds. Fig. 4 shows the corner of the shop where the balancing is done and the methods are interesting.

The standing balance is the first step and a pulley on the balancing ways can be seen behind the young man's left hand, which is resting on the ball of the weighted lever of the machine for getting the running balance. In the tote pan in the foreground will be seen a variety of sizes of balancing pads, which are of cast iron. Using a pat of a peculiar clay, which has the consistency of putty and the stick-to-itiveness of a postage stamp, he sticks one or more of the pads on the inside of the rim until the pulley is balanced in any position. Then he puts it on the revolving machine, as shown, which shows the "wabble," if there is any. A pulley may have a perfect standing balance and yet wabble badly on this machine because one part of the edge of the rim is heavier than the other. The chalk shows the high side and the pad is slid one way or the other across the rim to even this up, and takes out the wabble. When this has been done correctly, the pulley runs without a tremor and is in perfect balance. Then the pads are fastened in place and the pulley is done so far as this is concerned.

The machine at the right is for testing loose pulleys to see that the oiling system is in good order. This system includes a bushing of cast iron, which is fast to the shaft and which carries the loose pulley. This bushing is drilled parallel to the shaft as shown in the foreground and then small holes connect each of these reservoirs with the bearing surface on the outside of the bushing. The end of the bushing is grooved so as to connect these holes and a cap goes over the end with a paper washer between. These are seen under the pulley on the machine.

These hubs are filled with oil up to the shaft, which means that the four bottom holes will be full and that the oil will flow through the small holes to the bearing when the shaft is idle and the pulleys running. The circular groove at the end allows the oil to flow back to the bottom holes and the end plates prevent it from being thrown out. The machine shown revolves the bushing in the pulley to test the efficiency of the lubrication so that they will know positively that every loose pulley will run cool if it is properly filled with oil.

The rack in front, built of pipe fittings, is for filling the bushings and for draining the oil out of the pulleys after being tested.

An interesting feature in connection with this balancing machine, built by the Defiance Machine Works, Defiance, Ohio, is the necessity for a solid foundation. When first installed, it was mounted on the floor but never worked well until a concrete foundation from the ground up, was built under it. Since then it has been highly satisfactory in every way.

Assembling a Machine

The various parts of the machines are made in different parts of the shop and delivered to the stock room until needed. When a bed is ready to assemble the truck shown in Fig. 5 is loaded up in the stock room for that machine, taken down to the erecting floor, run up beside the machine so that all parts are handy for the erecting crew when they are ready, and all trotting back and forth is avoided. The tote pan on top of the truck contains the screws and bolts necessary for the machine, all parts being checked off at the store room and charged to the erecting department.

At the left of the bed is a portable motor which can be run around to any machine after it is erected and belt to it to drive it for a preliminary test, after which it goes to the testing floor, where it actually does business on the work it is designed for, so that they know it will work when set up in the shop or mill of the purchaser.

Special Tools

There are a number of interesting devices in this shop, a few of which are shown in Figs. 6, 7 and 8. The first is the method of making the air grooves in the "pneumatic" pulleys. These grooves let the air out from under the belt and are used on all the small pulleys which run at a high speed.

The oscillating device is bolted in front of the headstock of a regular lathe so that the face gear drives the eccentric on the lower shaft through the gears shown. This allows the number of waves per revolution to be regulated by change gears. The eccentric drives the bell crank and moves the carriage back and forth to produce the wave. When one wave has been cut the small hand-screw is loosened, the lever raised out of the notch in the rod, the carriage moved to the next notch and the operation repeated for the next groove. It does the work very quickly and does it well.

A machine which saves a lot of ratchet drilling was found in the drilling depart

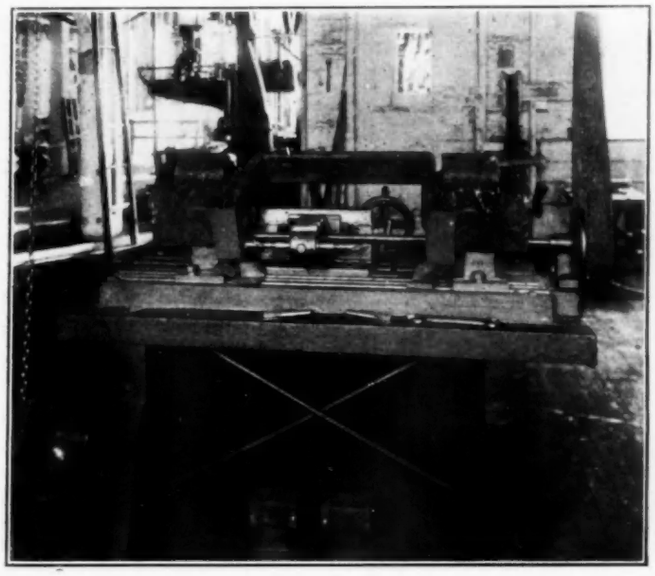


FIG. 7. SAVING HAND RATCHET WORK

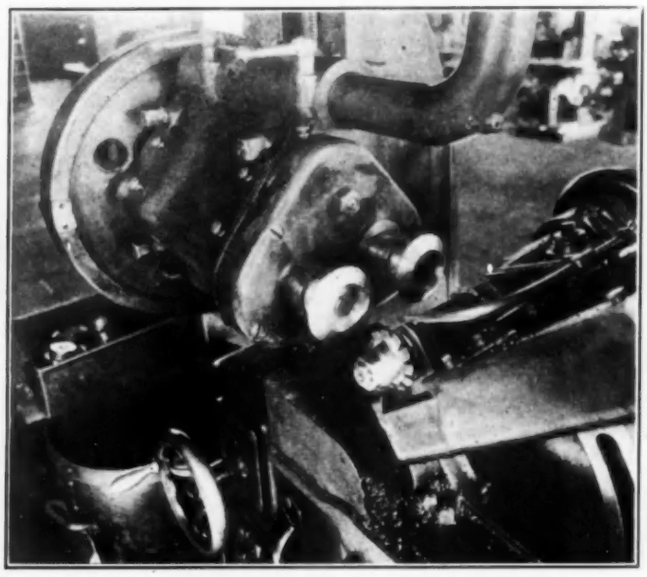


FIG. 8. CUTTING TWO BEVEL GEARS AT ONCE

ment and is shown in Fig. 7 being used in drilling such pieces as the ore shown. The holes on the inside of this yoke would naturally be done by hand, but the drill head shown, carrying both a right and a left-hand drill, is fed first to one side and then the other and does the work quickly. Furthermore it locates the holes accurately because the yoke rests on blocks which hold it in place so that the holes come in the right place every time. The drills are fed by the hand-wheel at the back with a pair of spiral gears to operate the screw.

Another time-saver is the addition of a double head to a Brown & Sharpe small gear cutter so that two bevel gears can be cut at once. It needs almost no explanation, the two cutters being located the same distance apart as the centers of the gear arbors, and the actual cutting time is reduced one-half.

I am indebted to both Mr. Woods and to Mr. Kimball, his superintendent, for the facts herein presented and for their assistance in securing these illustrations.

Alining Shafting by a Steel Wire

By A. H. Nourse

A number of the largest shipbuilding plants are using a method of alining propeller shafts by a steel wire, the sag of which for every 10 feet of its length is known. The method is equally applicable to semi-flexible shafting as line shafts in factories.

The wire used for the work is a high-grade, steel piano wire, No. 17 Birmingham wire gage. The accompanying table gives the sag of such a wire for various lengths between supports. Before obtaining the figures for this table the wire was stretched to its full length, and the greatest amount of weight at the end of weight-cord which the line would sustain with the least possible amount of sag was determined. It was then suspended over a trough filled with water, 300 feet long, 6 inches wide and 6 inches deep. This was located in a building in which there was no perceptible vibration, or sufficient circulation of air to disturb the surface of the water. The wire was securely fastened at one end, attached to the reel at the other and the sag at each point for the distances shown in the table was accurately measured. A metal float with a pin point in the center was used in calipering the sag. The column at the left of the table shows the total length in feet of the wire between its supports. The top horizontal row gives the distance in feet from the reel to the points at which the sag was measured. The fractional inch dimensions in the body of the table are the sags at the various points. The measurement at the extreme left in each horizontal row was taken at a point 10 feet from the reel; similarly the measurement at the extreme right in each horizontal row was taken at a point 10 feet from the end of the wire held by the fixed support.

For Propeller Shafts

Fig. 1 shows the arrangement of the wire when used for alining propeller-shaft bearings. Properly used this method is so accurate that all of the bearings, including those of the main engine, can be set so as to require no additional adjusting when the shaft has been lowered into place. To my positive knowledge the method was used on the war vessels in the following list: Battleships, "Connecticut," "Illinois," "Kearsarge" and "Kentucky;" gunboats, "Helena," "Nashville" and "Wilmington;" destroyers, "Truxton," "Whipple" and "Worden."

For Line Shafts

Steel wires are commonly used for the alining of factory line shaft, but the leveling is done by a spirit level or a surveyor's level. If the wire is properly located and the ends are brought to the same level it can be used to level as well as aline and will give much better results than ordinary methods. As a step-by-step process, which must be employed with a level, will increase any error which may be present, it follows that a method whereby the ends of the shaft are fixed in perfect level at the start, and then all of the other sections brought to the same position, is on a much better basis.

After the wire is once stretched it is very easy to measure from it for both the level and alinement.

The Wire Reel

The wire reel is illustrated by Fig. 2. It is intended to be secured upon a temporary base adapted to the location where it is to be used. Two adjustments are provided, one by screw No. 10 in a vertical direction, and the other by screw No. 11 in a horizontal direction. The wire can be led either way from the reel. An important point is that the diameter of the reel shall not be too small, and experience has shown that 3½ inches is about a minimum for this dimension.

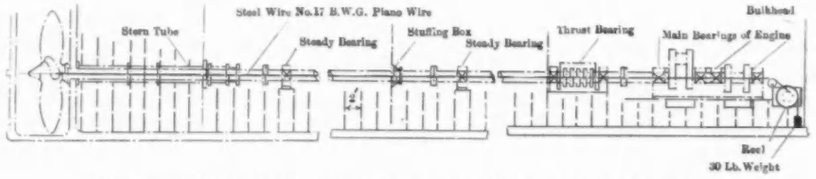


FIG. 1. ARRANGEMENT OF WIRE FOR ALINING A PROPELLER SHAFT

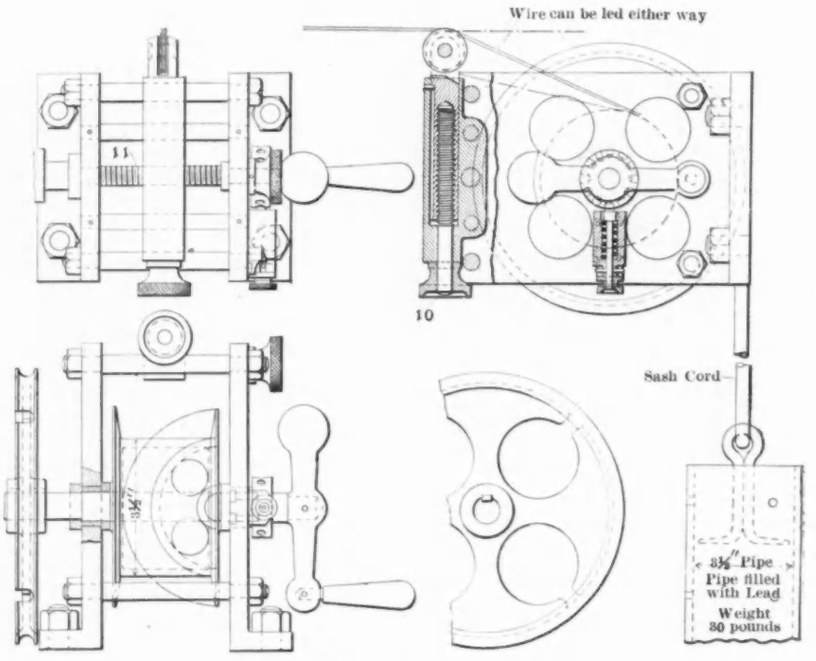


FIG. 2. DETAILS OF THE WIRE REEL

In welding by means of the oxy-acetylene blow-pipe the point of the flame is held 1 to 0.25 inch from the work. No fluxes are required for iron, steel and copper, but for brasses and bronzes a little borax or boracic acid moistened with water is used for the purpose of preventing the volatilized zinc from being deposited on the point and thus preventing a weld.

Sags of a Steel Alining Wire for Shafting

Distance in Feet, from Reel to Point of Measurement

Distance in Feet, from Reel to Point of Support

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270
290	1/4	31/64	11/16	57/64	1 1/16	1 7/32	1 23/64	1 31/64	1 37/64	1 43/64	1 47/64	1 25/32	1 13/16	1 53/64	1 13/16	1 25/32	1 47/64	1 43/64	1 37/64	1 31/64	1 23/64	1 7/32	1 1/16	57/64	11/16	31/64	1/4
280	15/64	15/32	43/64	55/64	1 1/64	1 11/64	1 19/64	1 13/32	1 1/2	1 37/64	1 41/64	1 43/64	1 11/16	1 11/16	1 43/64	1 41/64	1 37/64	1 1/2	1 13/32	1 19/64	1 11/64	1 1/64	55/64	43/64	15/32	15/64	
270	15/64	29/64	41/64	13/16	31/32	1 7/64	1 15/64	1 11/32	1 27/64	1 31/64	1 17/32	1 9/16	1 37/64	1 9/16	1 17/32	1 31/64	1 27/64	1 11/32	1 15/64	1 7/64	31/32	13/16	41/64	29/64	15/64		
260	7/32	27/64	39/64	25/32	15/16	1 1/16	1 11/64	1 9/32	1 11/32	1 13/32	1 7/16	1 15/32	1 15/32	1 7/16	1 13/32	1 11/32	1 9/32	1 11/64	1 1/16	15/16	25/32	39/64	27/64	7/32			
250	7/32	13/32	37/64	47/64	55/64	63/64	1 5/64	1 11/64	1 15/64	1 9/32	1 5/16	1 5/16	1 5/16	1 9/32	1 15/64	1 11/64	1 5/64	63/64	55/64	47/64	37/64	13/32	7/32				
240	13/64	3/8	35/64	45/64	13/16	59/64	1 1/64	1 3/32	1 5/32	1 5/16	1 13/64	1 13/64	1 5/16	1 5/32	1 5/32	1 1/64	59/64	13/16	45/64	35/64	3/8	13/64					
230	3/16	23/64	33/64	21/32	49/64	7/8	61/64	1 1/64	1 1/16	1 5/32	1 7/64	1 3/32	1 1/16	1 1/64	63/64	7/8	49/64	21/32	33/64	23/64	3/16						
220	11/64	11/32	1/2	5/8	23/32	15/16	57/64	61/64	63/64	1	1	63/64	61/64	57/64	15/16	23/32	5/8	1/2	11/32	11/64							
210	11/64	21/64	29/64	37/64	11/16	49/64	57/64	7/8	29/32	29/32	29/32	7/8	57/64	49/64	11/16	37/64	29/64	21/64	11/64								
200	5/32	19/64	7/16	35/64	41/64	23/32	49/64	15/16	57/64	57/64	15/16	49/64	23/32	41/64	35/64	7/16	19/64	5/32									
190	5/32	9/32	13/32	33/64	19/32	21/32	45/64	47/64	3/4	47/64	45/64	21/32	19/32	33/64	13/32	9/32	5/32										
180	9/64	17/64	3/8	15/32	35/64	39/64	41/64	21/32	21/32	41/64	39/64	35/64	15/32	3/8	17/64	9/64											
170	9/64	1/4	11/32	7/16	1/2	35/64	37/64	19/32	37/64	35/64	1/2	7/16	11/32	1/4	9/64												
160	9/64	15/64	21/64	13/32	19/64	1/2	33/64	33/64	1/2	29/64	13/32	21/64	13/64	9/64													
150	1/8	7/32	5/16	3/8	27/64	7/16	29/64	7/16	27/64	3/8	5/16	7/32	1/8														
140	7/64	13/64	19/64	23/64	25/64	13/32	13/32	25/64	23/64	19/64	13/64	7/64															
130	3/32	11/64	1/4	19/64	5/16	21/64	5/16	19/64	1/4	11/64	3/32																
120	3/32	5/32	7/32	17/64	9/32	9/32	17/64	7/32	5/32	3/32																	
110	3/32	9/64	3/16	7/32	15/64	7/32	3/16	9/64	3/32																		
100	5/64	1/8	5/32	11/64	11/64	5/32	1/8	5/64																			
90	1/16	7/64	1/8	9/64	1/8	7/64	1/16																				
80	3/64	3/32	7/64	7/64	3/32	3/64																					
70	1/32	1/16	1/16	1/16	1/32																						
60	1/32	3/64	3/64	1/32																							
50	1/64	1/32	1/64																								
40	1/64	1/64																									

Sag of the Wire in Inches

Explanatory: A steel wire is often used for alining shafting by stretching it parallel with the direction of the shaft and measuring from the shaft to the wire in a horizontal direction. This steel wire can also be used for leveling or alining in a direction at right angles to the other, by making vertical measurements, if it is stretched under established conditions and if the sags at the points of measurement are known.

The table gives the sags in inches from a truly level line passing through the points of support of the wire, at successive points beginning 10 feet from the reel and spaced 10 feet apart for a No. 17 Birmingham gage high grade piano wire, stretched with a weight of 30 pounds, wound on a reel of a minimum diameter of three and one half inches and for total distances between the reel and point of support of the wire varying by increments of 10 feet from 40 to 290 feet. Thus a wire of any convenient length, of the kind indicated, can be selected, so long as this length is a multiple of 10 feet and between the limits specified, and the table gives the sags from a truly level line at points 10 feet apart for its entire length when it is stretched under the conditions designated. These sags being known, direct measurements can be made to level or aline a shaft by vertical measurements.

The method was originally developed for alining the propeller shafts of vessels, but it is equally serviceable for semi-flexible shafting, as factory line shafts.

Threading, Tapping and Drilling Machines

Automatic Machines with Equipment for Threading External Work, Drilling Holes and Tapping Nuts Fed from a Magazine

SPECIAL CORRESPONDENCE

In the accompanying engravings are illustrated several automatic machines manufactured by the Fay Machine Tool Company, of Philadelphia, Penn., whose automatic lathe we described in detail at page 677, Vol. 30, Part 2. It will be noticed that, while each machine here shown is constructed for one operation, the general design is much the same as in the case of the lathe already illustrated.

Figs. 1 and 2 show front and rear views of an automatic threading lathe designed for cutting threads on various classes of work by means of three chasers carried on radially adjustable jaws in a form of chuck on the head spindle. These chasers are shown clearly in the rear view and details are given in the line drawing, Fig. 3. The chasers are not threaded spirally, but are provided with a series of peripheral teeth cut straight around the circumference, the tool being adapted for sharpening by grinding on the face, as shown, until completely used up. Against the shank of each chaser is forced a binding bushing, whose head contacting with the concave groove about the shank carries the chaser hard against the stop pin in the face of the sliding jaw. The jaws are beveled at their outer ends to engage with similarly beveled grooves in the chuck shell, and upon the latter being drawn back upon completion of the threading operation the chasers automatically spring open and allow the work to be withdrawn without reversing the spindle. The general construction of this device is clearly shown in the detailed drawing, and needs no further explanation.

Fig. 4 illustrates the type of turret used on this form of lathe. The base of the turret in which the indexing notches are formed is adapted to receive upon its upper surface the turret proper, which is in the form of a ring of suitable contour and dimensions to accommodate the class of work it is especially intended to handle. The indexing notches are cut in the exterior of the turret and the locking bolt extends clear under the turret and is drawn into the notch on the front side when securing the turret after each indexing movement.

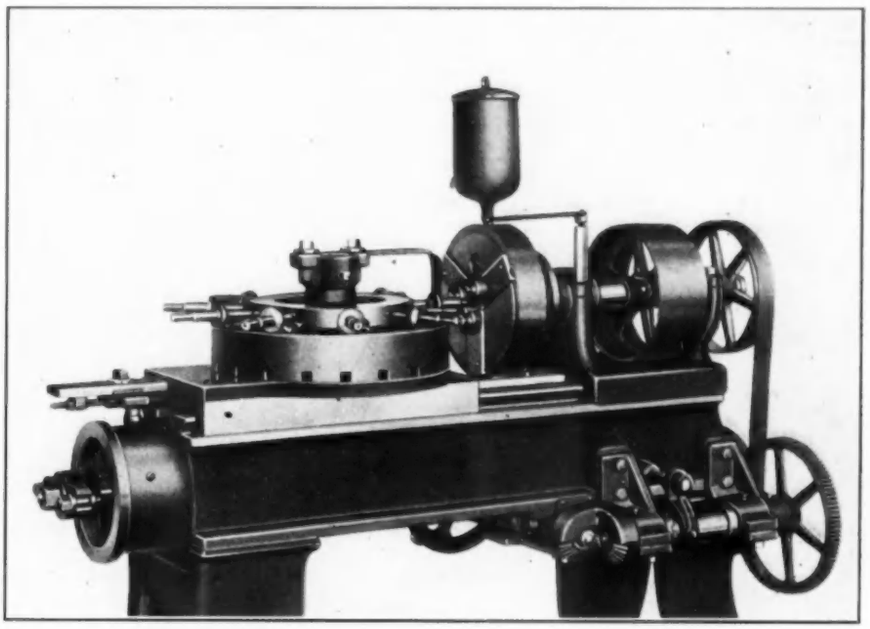


FIG. 2. AUTOMATIC THREADING LATHE—REAR VIEW

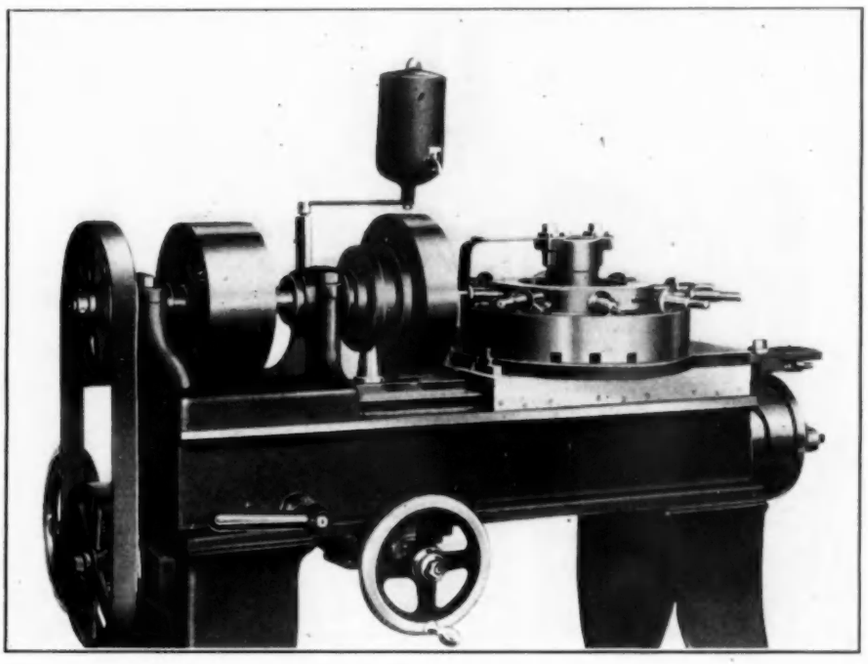


FIG. 1. AUTOMATIC THREADING LATHE

By referring again to Figs. 1 and 2, the method of driving the spindle and the cam shaft will be understood. The cam drum is seen at the lower end of the bed and the cross shaft which drives the cam shaft is shown clearly in the rear view. When desired the rate of speed of the shaft may be varied by changing the spur gears in the train at the head of the bed. The clutch on the bevel-gear driving shaft at the rear is controlled by the handle shown in horizontal position under the head and at the front of the machine. The hand wheel shown in the front view is used for operating the turret slide by hand when setting up a job. The chaser jaws are opened and closed by a slide operated by a cam on the shaft below, a roll on a stud under the slide fitting a groove in the cam. A second roll mounted upon the upper end of the stud enters the groove shown in the chuck-operating ring. The turret slide is operated by cams on the drum and this slide carries an auxiliary slide in which is secured the locking bolt for the turret, the withdrawal

of the bolt being accomplished by another cam on the turret-slide drum. With this machine the operator merely has to slip the work into place as the turret revolves, the latter thus acting as a form of magazine feed.

In Fig. 5 is illustrated an automatic nut-tapping machine equipped with a magazine feed The nuts as they drop from the magazine enter between two hardened steel jaws carried in a pair of turrets. The trunnions of the turret members are in a pair of brackets set at a slight angle to one another, the jaws thus being brought somewhat closer together at the front side than at the rear. As the nuts enter the jaws the latter are rotated forward and bind the work securely before it is operated upon. One of

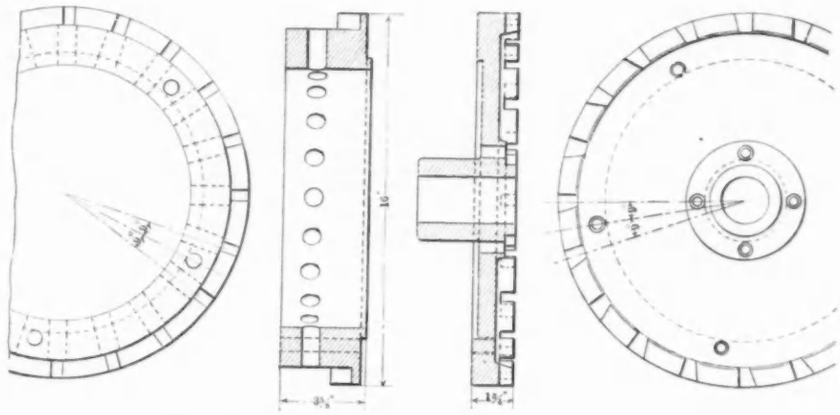


FIG. 4. TURRET FOR AUTOMATIC THREADING LATHE

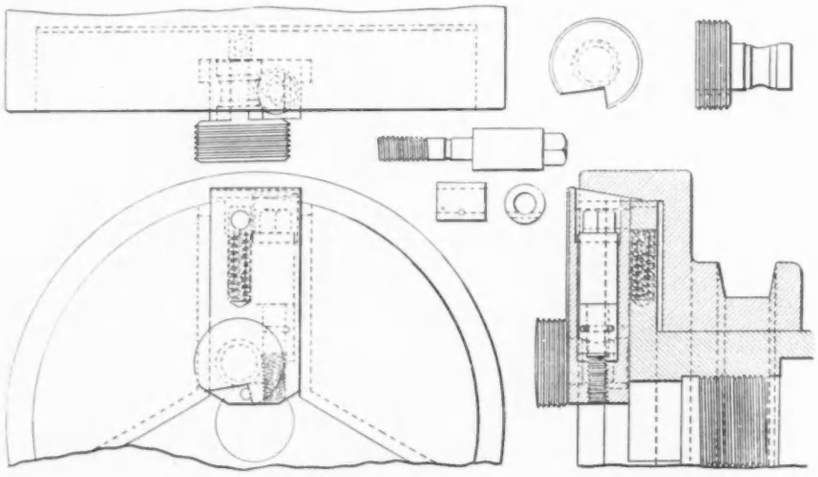


FIG. 3. CHASER HEAD FOR AUTOMATIC THREADING LATHE

the two turret members is shown in Fig. 6, together with several other details. In each of the turret disks is fitted an internal ratchet, and between the two is a pawl which operates the two disks, these parts being shown in Fig. 6. The pawl is pivoted to the block shown immediately behind the turret in Fig. 5. The locking device in this case is a steel blade extending across the faces of both turret disks. The pawl and lock are both carried on an auxiliary slide moving in a guide formed in the top of the main turret slide, the operation of the upper slide being controlled by cams on the drum shown at the end of the bed. The form of tap used in this machine is shown in Fig. 7, and as there illustrated, the end forms a chucking drill which first sizes the hole in the nut before the tap starts to do its work. This tapping tool is a sliding fit in the spindle to which it is feathered. Behind this is a facing tool which finishes the front of the nut while the thread is being cut. The spindle is driven by open and cross belts and on completion of the tapping operation the reversing clutch between the spindle and pulley causes the backward drive of the spindle to come into action and withdraw the tap from the work. As the turret indexes forward each nut as completed drops out at the bottom.

An automatic drilling machine is illustrated in Fig. 8. In general principle this machine is like the two others illustrated. The turret is similar to the one shown in Figs. 1 to 4, and is constructed to suit the class of work which is to be drilled. The locking slide placed longitudinally of the turret slide is shown clearly, as is also the adjusting mechanism by which the turret drum is shifted longitudinally on its shaft, so that work of various lengths may be accommodated. Rear views of the tapping and drilling machines are not shown as the mechanism at the rear is practically the same as that in Fig. 2, illustrating the threading lathe.

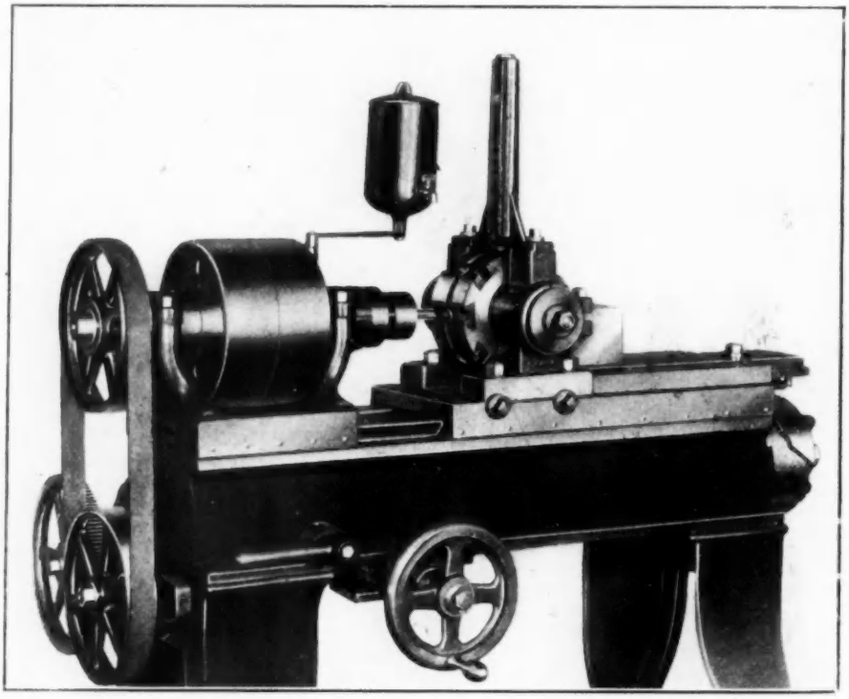


FIG. 5. AUTOMATIC NUT-TAPPING MACHINE

Echoes from the Oil Country—Should Results or Time be Paid For?

By W. Osborne

The superintendent rubbed his hand over the part of his head where the flowing locks used to be while he considered a letter which he held in his hand. It had come to him from the general office along with an order for a man who was wanted to repair an engine and contained all the information to be had on the subject. This letter was very specific in stating that the man was wanted at once, and in telling him how to get to the mill, but beyond stating that it was an engine which was to be repaired and that it would not run in its present condition, it did not give any hint as to the real trouble. This omission was what was causing the superintendent to worry. Whom should he send to do the job? He knew that they were using one of his gas engines and he also knew that they used several steam engines and two locomotives, and had several small mills scattered around near the large one and each one of these had at least one engine in it.

The call was urgent and it was nearly train time, with no other train until the next day. Likely someone had been "monkeying" with the gas engine and they could not get it started.

"Sam, get ready for the 11:19 train. Go up the river to Hickory and get a rig and drive out to Snyder's mills. They have an engine that will not run. I guess that it must be that engine of ours that we sent them about four months ago. If it should not be that but be a steam engine you know enough to set a valve, don't you?"

Sam nodded his head to express his ability.

"Take everything that you think you might need in the way of tools and material. The office will give you money for expenses."

Sam went as directed. After leaving the railroad he still had a drive of twelve miles. It was dark by the time he got to the mill and had some supper at the boarding house. His dinner had consisted of two sandwiches and a cup of coffee hastily swallowed at a restaurant at the station before he started.

Immediately after supper he was taken to the mill where he was expected to exercise the magic of his art on the perverse gas engine. Being after working hours, the mill was not running in any department and it seemed to Sam as though every man in the place was interested to the extent of making one of the audience which crowded into the room to watch him work. Sam was not used to performing in public and the crowd did not help to steady his nerves or make him think any faster or clearer.

The superintendent and engineer and head sawyer were the ones who did the talking to him but several of the others did some that was evidently aimed at him, but nothing that he heard while on the way to the engine did him any good as far as showing him what was the matter.

The mill was not fitted up with light so as to be operated after dark so a couple of lanterns served for illumination, but it was not brilliant enough to give a man a good general view of the engine which had a very unfamiliar look to Sam in the gloom. After he had prowled around it for a bit it came to him that while this might be a gas engine it was not such a one as he had been accustomed to. It had not been made by

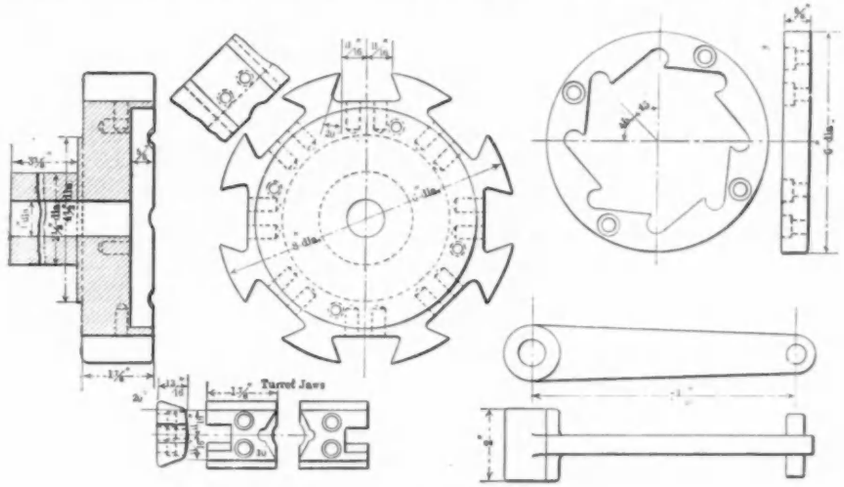


FIG. 6. DETAILS OF TURRET FOR NUT-TAPPING MACHINE

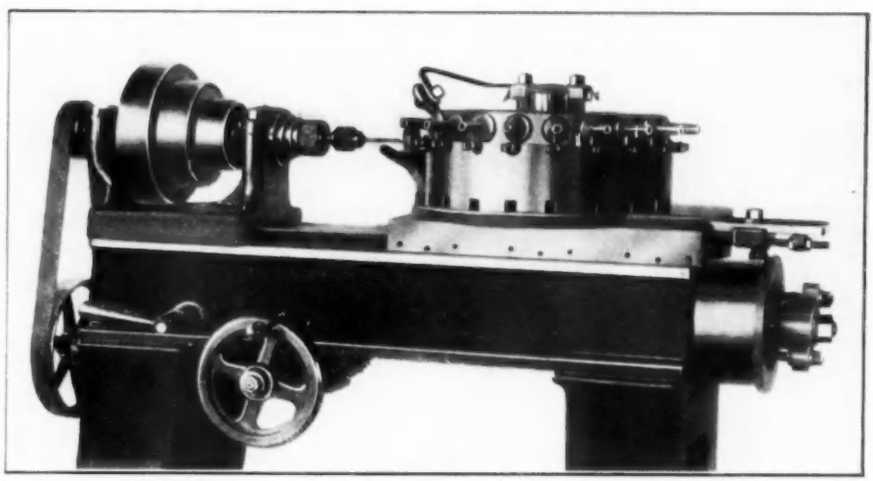


FIG. 8. AUTOMATIC DRILLING MACHINE

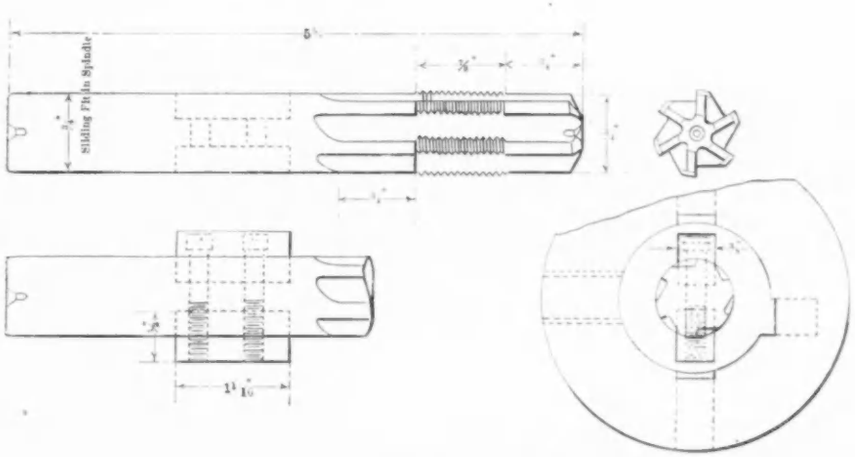


FIG. 7. COMBINED DRILL AND TAP

the company that he worked for. He had never seen anything like it, and when he found the name-plate and got it wiped clean enough to make out the name, he found that he had never even heard of the makers.

"How long will it take you to get her going?" asked the superintendent.

"What is the matter with her anyhow?" asked the engineer.

"Can't you give her a little more power while you are at it?" asked the sawyer.

Sam could not give a direct answer to any of these questions. He wished he was back in the shop where he could work and feel at home.

"This engine is quite a lot different from the ones we make. I never saw one like it before." He felt that he had to say something. "Why don't she run for you?"

"If we knew what was the matter with her you don't suppose we would send for a machinist, do you?" asked the superintendent. He gave Sam a keen look and added, "You are a first-class machinist, are you not?" Sam hastened to assure him, and all others within hearing, that he had always been able to hold his own with the best men in every shop where he had worked, and started in on the engine.

He could not find anything broken and was told that they had not been able to find anything broken. The engine was not very large and the starting was done by hand. Sam pulled until his arms felt as though they were ready to drop off and his back ached, but without getting any signs of starting. He tore things apart and put them together again and was told that this had been done before. He examined valves and joints. He tried various mixtures. He tried to think of all the gas-engine kinks of which he had ever heard. After his best endeavors the engine still refused to move except when human muscle was applied. About midnight he gave it up for the night. In the morning the same performance was gone through with and the results were the same.

While Sam was a good machinist in the ordinary sense of the word he was lame on theory. His ideas in regard to the conditions necessary to obtain combustion in a gas engine were not of a general nature. He knew that certain combinations produced conditions in the engine with which he was familiar under which it would run and be reliable. He knew how to arrange the parts so as to get the right combination. Beyond this he did not know. Why the combination made it run was not known.

He left the mill that evening in time to get the night train home without having been able to get the engine started or to tell why it would not go.

He reported his lack of success to the superintendent with the added opinion that from remarks dropped from the men he thought the engine was not much good even when it was running.

After hearing the name of the makers of the engine the superintendent went to one of the men who had worked for them and found that he knew something about their gas engines. He was not rated as being as good a machinist as Sam, but he had worked for a time on the assembling floor of the other shop.

David, that was the name of the last man sent from the shop, put everything into place just as he had been taught to do in the shop where the engine was made and on the first trial the engine started off as nicely as anybody could wish.

Now there is a very delicate matter in the hands of the office for adjustment. The lumber company feels that they should not be charged for the services and expenses of a man who did not do them any good or know any more about their engine than they did themselves, while the superintendent feels that he did the best he could, under the circumstances, to send them a competent man. He knows that he has not a man about the place who knows it all about machinery. If he has to guarantee results under all conditions he wants mechanical engineers with shop training to send out, and one for each separate division of mechanics at that. The office wants to keep good customers and keep them feeling right, at the same time they know that the settlement made in this case will act as a precedent to be reckoned with in the future.

An Actual Trade School

By F. A. Pratt

The editorial on page 256 presents a phase of industrial education, or more properly training, which is exceedingly important and has been but little mentioned. I do not believe you will find many men who have been actual teachers in trade schools advocating the goods-on-the-market idea. The reason is simply this: If the goods made are to be sold the student cannot be getting any new experience while he is making them. He must be capable of making a commercially perfect piece before he can make it good enough for the market; if he can make a commercially perfect piece what business has he working on it as a student? A student in industrial work should, first, be trained and, second, perfected; that is, brought to that point where he can do work commercially perfect. When he arrives at this stage he should leave the school.

A Trade-school Machinist's Course

Since experience is the best schoolmaster, I am going to present the outline of the machinist trade course of a school in which I taught for five years. We manufactured, jobbed and made our drawings, yet we never sold an article in the market. The State did not want it; manufacturers did not want it; we did not want it. The question is not: Can goods be made in the school and marketed? They most certainly can. But trade schools should attempt to teach a trade; they should not mix money making with it. The school which I mention was not a manual-training school, but a trade school, pure and simple. A boy spent 34½ hours a week in the machine shop, 12 hours a week in the school room and 3 hours a week in the drawing room. Daily hours were from 7 a.m. to 6 p.m. in summer, 7:30 a.m. to 6 p.m. in winter. The trades departments and school rooms were under separate teachers. The same hours were in order for the carpenters, masons, printers, blacksmiths, farmers and machinists; all of which branches were taught and an instructor was maintained in each of these lines. In the machine shop we manufactured—on a small scale to be sure—with 16 to 20 students. When we made twist drills we made a number; reamers, several of each size; calipers, 25 or 30 pair at a time, and so on through the whole line of our goods. As a jobbing experience we did all of our own repairs at the shop, and the machinery repairs for other parts of the school; repairing printing presses, sewing machines, wood-working machinery, blowers for the forge shop, or anything that broke down. This work had to take its proper place in a boy's course, however, and it came late after he was a fair all around machine hand. He was not kept on it after he had developed ability to take hold of, and successfully rig up for and do, an ordinary job in repair work.

Much of the success of such an organization depends on proper management. One of the first things to be considered is the length of time a student should spend in such a school, yet having his time devoted entirely to training. We had the boy for two years; finding this a sufficient length of time to turn out a fairly good workman. Not an expert, but a sufficiently all around trained man to go out and earn living pay and give satisfaction to his employer; with his mind in such shape that he could read the trade journals of his line, and build himself up into any grade of man which he saw fit. No apprentice course does more than this. During the five years of my time at this school none of the boys ever entered a shop as an apprentice, although some left as young as 15 years, while others were as old as 19 years. The boy of 15 years of age went to work for $6 per week, was raised to $8, and the last I heard from him he was getting $9, and was at that time 15½ years old. The boy of 19 years of age went to work for $12 a week, and the last record showed that he was receiving $13.50. Another boy

left us at 21 and is now getting $70 per month. I mention these extreme cases to show that they were not manual-training boys, but had a knowledge of the machinist's trade, which enabled them to earn good pay considering their age. Their school training enabled them to enter their trade direct. My experience has led me to believe that two years is a sufficient length of time in a well planned and properly carried out course, to teach a boy a trade; that is, if he is capable of learning it. Not all boys made a success in learning the machinist's trade; such ones were usually dropped from the class. The time mentioned was just sufficient in our case to train a boy so that he could do a fair job; a longer time would have made him continue doing some things which he could already do well. A school should not follow such a plan. So one thing we may put down as an axiom in good trade-school work: Keep a man till he is proficient, then let him go. Our school period was two years of 50 weeks each, with 34½ hours per week in the shop.

Order of the Work

Now as to the order of a boy's work: When he first came to the machine shop he took a desk in the shop and started reading "Chordal's Letters," then he wrote compositions on what he had read, to be marked by the instructor, or else he told the instructor the story of a certain part of the book. The purpose was to give him some good every-day English and get him in a "shoppy" frame of mind. Next he took up Van Dervoort's "Modern Machine Shop Tools," and studied certain parts of this, going to the particular machine he was studying whenever there was anything he did not understand. This went a step farther and took him from the shop stories to the tools used in the shop, both large and small.

After he had completed these text studies he started on a series of bench exercises to teach him to chip, to file, to draw-file, to polish, to buff, to broach and to ratchet. Next he went to the drill press, doing a series of carefully planned exercises; then to the lathe, planer, grinder and miller, doing a thorough series of exercises on each. These were to make him perfectly familiar and at ease with his machine. The machine was never allowed to be made "fool proof"; *all feeds and attachments were left in place.* Up to this point the boy had produced nothing but exercises. Their purpose was to make him skilful so that when he started to do a job he would not have the double care of training his hands and looking after job details at the same time.

The course was thus divided into two sections — the "training" part and the "perfecting" part. The training part required about 40 per cent. of the time. The remainder was spent in making commercial articles and in jobbing. Of course, many mistakes were made; much work was spoiled; but a boy was kept on a certain grade of work till he could do it commercially accurate. If he was turning twist drills he would have to get out 25 to grinding size, in commercial time, before leaving the job. There is much detail here which I am not presenting, as of course the work was not always twist drills; we made drills, reamers, taps, bolts and nuts, clamps, dies, calipers, squares, hammers, drill-press collets, 6-inch and 12-inch monkey wrenches, and a variety of such tools in lots of from 10 to 25. Even at this we had to buy drills, etc., in the market. Most teachers will agree with me, I think, when I say that students can beat out anything else for smashing small tools.

Of course, we could have put goods on the market if, instead of giving the student a good, full, well-rounded training, we had started him at, say, turning mandrels. In a week's time I could have had him good enough to turn mandrels, and by making him stay six weeks on this job I could have made money. But what would he know about simple thread cutting, or taper turning, or compound gearing for threads, or cutting a thread without reversing his lathe, or boring a taper hole when he had no reamer, or the use of the protractor, or any one of the many things he ought to know to be a good lathe hand? Nor could I, if I had been marketing goods, have given him so thorough a course without holding him an abnormal length of time. Each boy when leaving was given a set of tools consisting of an inside and outside caliper, a 6-inch scale, a divider, a "morphodite," try-square, keyseat rule, surface gage, straight-edge, scratch awl and center punch. All of these, except the scale, were made at the school, complete from the rough bar. This part of our supplies alone gave us lots of work.

Some have said that we could do this in the machine shop, because the machinist makes a great many of his own tools; yet the carpenters built chairs, stools, desks, closets, benches, tables, wrench handles, hammer handles, and made mallets; after, of course, a proper series of exercises.

The smith shop made all the tools and tool holders for the machine shop, all of the hammer forgings and forgings for fixtures, chandeliers and ornamental iron work. In this particular case we had more than we could do in making our own goods; nevertheless, we had ample opportunity to give commercial practice, both as to time and in accuracy.

Keep Out of the Market

The editor certainly hits the nail on the head when he says, "Keep out of the market." It is almost certain that a school going into the market will curtail the students' training. Ideal training from the students' standpoint is such that just as soon as he is proficient and can stand alone in one line he is given something new, and so on until he is trained and perfected in all branches. Then he should be allowed to go.

Good management should see to it that in the school equipment there is left a place for the school's manufactured product. Thus a school should not buy all the tables, benches and stools it wants, or even have all of its departments complete when it starts. If it is to teach carpentry, it should get as few fixtures as possible and plan to make the rest. By the time they are well caught up in all lines, my experience has been that a number of the first ones are about ready to scrap.

Such a school costs money, but not nearly as much as some think. The annual expense per capita in this school was surprisingly low. Any State which takes up trade training must be willing to pay the price. To establish a trade school on a basis of paying for itself, or as a source of revenue, is a great mistake. In this school the State purchased all rough stock and all material for exercise work. The student purchased nothing. The number of boys in the classes ran from 16 to 20; the average in the school was 350.

Some Pertinent Questions

As to the labor problem the question becomes: Do our manufacturers need to such an extent the type of man a trade school can turn out, that they will stand any increased tax rate which such a school or schools may make necessary in their State? Reduced to its last analysis as far as they are concerned it is: Can they train the future industrial worker as thoroughly and as cheaply in their factories as they can have them trained in schools?

The social economist has this question: Are there places enough for the graduates of these trade schools, at a rate of pay which is commensurate with their knowledge, to make the project worth while?

If so many men of a certain type are on the market, that the competition becomes so great for places that the rate of pay for a skilled man is less than that for an unskilled one, there is no advantage in a man's spending time to make himself skilful. To cite a case: Some years ago in one of our Eastern cities during a crisis face-brick layers received $9 a week, while dock laborers received $10 to $11. If such a condition were to become permanent, due to great numbers fitting for one line and attempting to follow it, the standard of living must be lowered. Such a trend is not for the good of the country at large, the workman or the manufacturer.

The conclusion which one must draw from what manufacturers tell us about lack of skilled help is that some trade

schools could be very safely and wisely established; however, not one in every State in the Union at present. But schools should be started on a business-like basis with this question carefully considered: Are the trade schools which are in existence finding more places than they have men to fill at business rates of pay? If they are there is room for another one somewhere.

Referring again to the school I have in mind, I can say that during five years every boy who went out had a place at better pay than the average boy of his age. We often had calls for boys and we could have placed more than we did. Manufacturers were fair minded and always gave us consideration, in spite of the fact that the class of boys we handled had handicaps not placed upon the average trade-school student.

Hobbing Bevel Gears with a Taper Hob

A New Principle in Gear Hobbing Employing a Taper Hob and the Special Machine Designed for the Work

BY E. GREGORY

This principle, hob and machine, represent yet another development of the now well known hobbing method of cutting gears. Hitherto the pitch diameter of the hob has been a constant and uniform pitch. In this machine is employed a hob of varying pitch and of a conical pitch surface.

Before explaining the machine it will be necessary to briefly examine this hob and the principle of its application. From Fig. 1 it will be seen that the hob itself is tapering and that the tooth thickness, or pitch, is varying, being the greatest at the largest diameter. The pitch at any point is proportional to its distance from the apex, that is to say, if at 6 inches from the apex the tooth thickness is 2 inches, then at 12 inches from the apex it will be 4 inches. The rate of increase or decrease follows what Lord Kelvin called "The Compound Interest Law," or $Y = E^x$. It can be shown that the development of this spiral has a constant angle to the apex, thus proving that this special hob, like all others, has a constant spiral angle which is, of course, essential. Thus we see that it will cut gears of any number of teeth and any pitch within its range on ordinary spur and spiral gears. This type of hob has been patented by F. J. Bostock, of Birmingham, England.

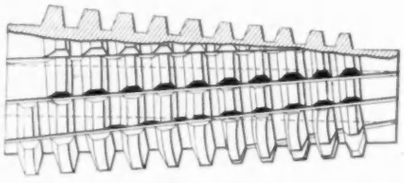


FIG. 1. A TAPER DIFFERENTIAL HOB

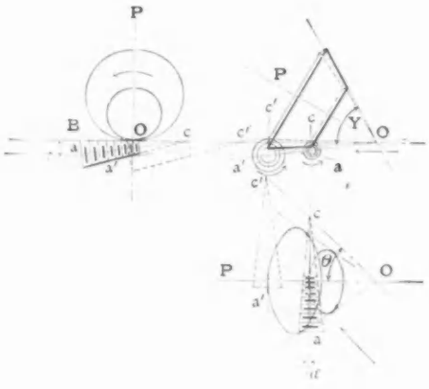


FIG. 2. ACTION OF HOB IN CUTTING BEVEL GEARS

The thickness of the tooth of a bevel gear varies in proportion to its distance from the apex and coincides with the alteration in pitch of the hob, as shown in Fig. 6. The condition, therefore, for cutting is that the hob moves in an angular direction θ, whose tangent is the distance of the cutting tooth of the hob from its apex, divided by the distance from the gear's apex to part being cut; obtained in practice from tables. Referring to Fig. 2, AC is the initial position of the hob, while $A'C'$ is the final one. The tooth is cut radial automatically as explained. By suitable angular setting and differentiation to compensate for side travel a ready method is available for cutting skew bevels.

The Machine

The main casting of the machine forms a horizontal bed and an upright face, both machined for the sliding surfaces of saddles. See Figs. 3, 4 and 5. The horizontal saddle *44* carries the hob suitably mounted and driven from a shaft *35*. The vertical saddle, or slide *5*, carries by means of trunnions *6* a head for mounting the gear blanks. This is suitably pivoted so that it can be swung around to enable the pitch line of the blank to be set parallel to the horizontal table. The spindle *7* carrying the blank is driven by means of bevel and worm gears from a side vertical shaft *15*, which in turn is directly driven by gears in the change speed box at the rear of the machine. Turning again to the horizontal saddle it will be noticed that it is composed of tables, *47*, *48*, *49*, so arranged that *47* and *48* can be swung round to any angle in relation to *44*. The table *49*, of course, remains in the same position with respect to the slides of the horizontal bed, and when *47* and *48* are at an angle with *44*, *49* will move bodily at an angle

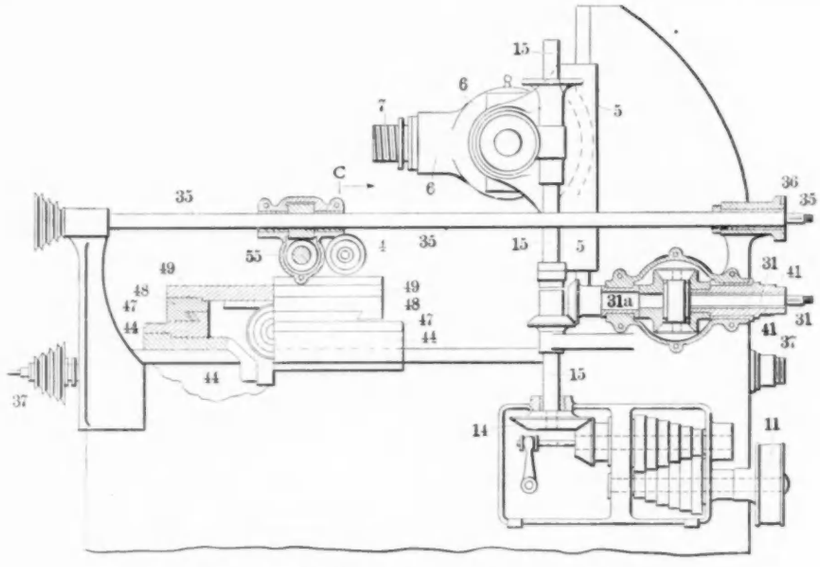


FIG. 3. GEM CUTTER USING A TAPER DIFFERENTIAL HOB

with *44*. This motion is only in a direction at right angles to the horizontal bed and is obtained by a master under the table *44*, and by moving the table *49*. See Fig. 5. Thus for one revolution of the master the hob is always moved a predetermined amount which is independent of the angle of *47* and *48*.

The motion of the shaft *35* is transmitted to the shaft *55* by special gears; thence to the hob *4*. On one extremity of *35*, however, is fixed a cone pulley, which causes the shaft *37* to revolve. This in turn drives the master and so moves the tables *49* upward so that the hob is caused to move the required direction in relation to the blank on the spindle *7* and during the cutting of bevels the saddle *44* is locked on the bed. The main drive is obtained from a single pulley *11* and transmitted to *15* at variable speeds by means of a sliding key, which is operated from the front of the machine by the handle *13*. From *15* the shaft *19* derives its motion and drives the blank arbor directly. Miter bevels intercept the shaft *15* and give motion to *31a*, thence to *31* and *41*, which are balanced, or constitute a differential gear. From this the shaft *31* is driven by means of change gears, according to the number of teeth required, which are inserted between *31* and *15*, thus driving *35* and so the hob *4*.

As before mentioned, the shaft *37* derives its motion from *35* and so drives the hob. On the other extremity of *37* change gears are placed gearing into *41*, which have the effect of retarding or increasing the speed of *31*, thus balancing all of the motions. This balancing is most essential

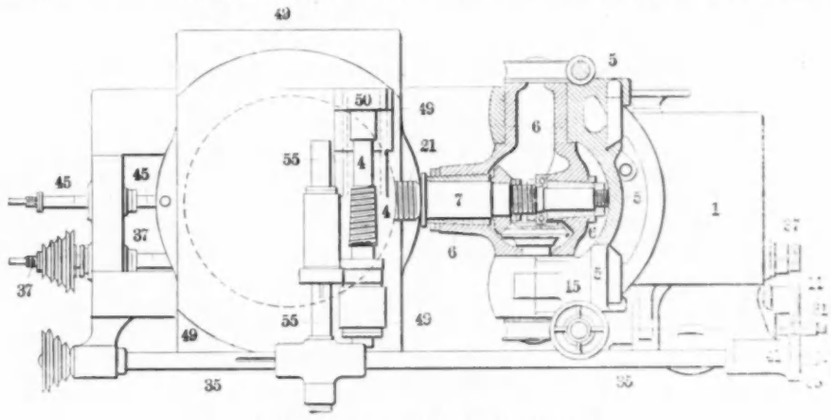


FIG. 4. TOP VIEW OF GEAR CUTTER

because, as the hob travels sideways on the blank, the hob's relative velocity must be modified accordingly. In order to use only one master for pitches varying from 3/16 to ¾ inch the gears placed between *41* and *37* are three in number, and those in gear are such that the velocity of the shaft *37* is modified accordingly. A whole range of gears are provided for shafts *31* and *35*, according to the number of teeth in the blank. The various other parts of the machine are self explanatory.

In order to cut spur gears the tables *47* and *48* are locked, the pulley is removed from *37* and placed on *45* so that the whole saddle moves along the bed; thus the balancing gear is out of action. Motion is transmitted directly from *31a* to *31*.

Modifications of the top tables will

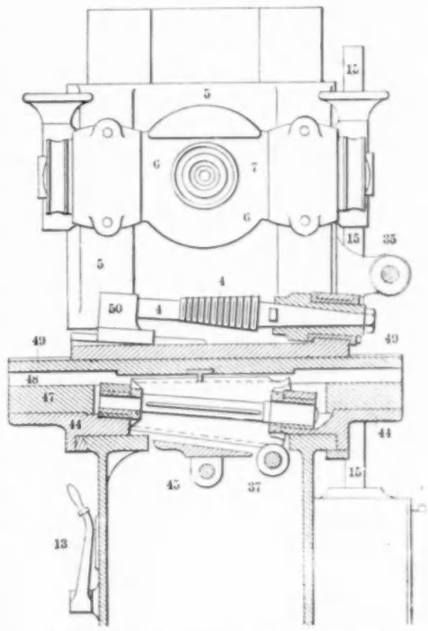


FIG. 5. END VIEW OF GEAR CUTTER

allow for the cutting of spiral or skew bevels. One hob will cut all pitches within its range, three hobs cut all pitches from 3/16 to ¾ inch. Arrangements are also made for setting the hob and blank along the table *50*.

The manner of cutting master hobs may be interesting. A blank is first turned to the requisite taper and then mounted in a universal milling machine and gashed to a certain depth. Each gashing operation is done at 6 degrees. At each 6 degrees of the setting the table is moved along a few thousandths, which are ever on the increase, hence giving a spiral groove of increasing pitch. This increase follows a well known law, and all settings can be obtained to 5 places of decimals from the tables. When the master hob is finished and the thread tested, it is mounted on a thread-milling machine and others made from it.

Selecting a Machine Equipment

By John R. Godfrey

There's more in selecting a machine for your shop than some seem to think, and local conditions have to be seriously considered. No one denies the desirability of electrically driven tools. They can be set at any angle, in any corner and be run overtime without affecting any other tool. Power cost stops when the lathe is idle and is in direct proportion to the work at all times; but in spite of this, can I afford to put in one tool of this kind when all the others are driven by overhead countershafts?

If my work is regular manufacturing in quantity, my lathes will be used on very much the same class of work at all times. If they do any thread cutting it will be confined to a very few pitches, and few changes of gears will be necessary. This being the case, why should I buy a lathe with a screw-cutting feed box, which costs more than the old-fashioned lathe and is worth all it costs if you use it often enough? But for plain turning in manufacturing with an occasional thread, is it the lathe for me to buy?

When you come to figure it out, what percentage of the average lathe work is thread cutting anyhow? Is it enough to warrant this expense for regular work?

If my work is varied, as in a job shop or in making a few parts alike instead of much duplication, there might be no question as to the value of the screw-cutting device, as it would save a large amount of time in changing gears; it ought also to save mistakes being made, which are always expensive. But when we know there is a demand for a lathe which only turns and cuts no threads at all, it looks as though there must be many places where the screw-cutting device must be a needless expense.

There is one feature, however, that must be laid to the credit of the change-gear box; it has practically done away with the old rod feed with its dinkey little belt that was about right for a sewing machine. It never did pull a decent cut, and if for no other reason we ought to take off our hats to the change-gear box. But for rapid changes for screw cutting its chief value seems to be in the talking point for selling the lathe; for regular work, aside from the geared-feed feature, I do not believe it is worth what it costs.

Constant-speed Drives

The constant-speed drive is a little different. This is a time saver on all kinds of work, as it makes it easier for the machinist to get the right speed. It is much more convenient throwing a small lever than it is coaxing a belt on to the right step every time you want a little change of speed. Of course a man gets very expert at it, but it is usually too much to

expect that he will do this every time unless he is working piece work. Even then he can probably save time by not changing speeds as he would with all the speed changes in the head, controlled by a lever. But even here we must remember that these gears will wear out the same as a belt, and if we speed up the lathe we can count on the wear being even more rapid than the increase of speed. Just how much is difficult to say, although some builders of machines claim it increases as the square of the speed; but this seems rather high to me. We do know that they wear out much faster, and this seems to point out that steel gears are none too good for any high-speed driving work. What we must determine is whether it pays, in our particular case, to wear out a tool in 5 years or in 15. Do we get as much total work out of it as before, or does the difference in the cost of the plant chargeable to this tool, the burden as some call it, make up for the decrease in total output?

The Automatic Machine

Then there is the question of automatic machines. When we go into a shop and see a boy chopping off light, square stock with a sort of paper cutter, then pointing these in a little hand lathe, we get the idea that this shop is several laps behind the times, as this appears to be just the job for the small automatic screw machine. But in this particular case the boy is turning out about double the quantity per day that the builder of the automatic guaranteed, and we can see his point of view much better than before we knew this phase of the situation. It seems all wrong that this should be so, and perhaps the builder underestimated the capacity of his machine; but would you buy one yourself under such conditions?

There is another phase of the machine-output question that is sometimes overlooked, the time taken to handle work in the machine. If it takes a man five minutes to chuck a piece of work that can be machined in 10 minutes and you reduce the working time to five minutes, you have saved only one-third instead of one-half the total time. Of course this is a very simple proposition, but it is too often overlooked in figuring the saving to be had from a new machine. Not that it does not pay to save one-third the time or even 10 per cent. of it; but there is apt to be disappointment if the results are not as large as anticipated, and we must figure to find which is cheaper, to use a little more time on the operation or pay interest on the investment.

At a recent meeting of the National Association of German Manufacturers of Iron and Steel it was stated that the industry had been unusually prosperous during the past year and that the output had been materially increased, caused principally by the home demand, which was created by favorable trade conditions.

Machining Small Curved Cylinders and Pistons

By Francis J. Bostock

Some four or five years ago my employers undertook to machine a few sets of parts of a rotary engine for an inventor. The cylinders and pistons resembled a portion of a ring of a circular section. Figs. 1, 2 and 3 give some idea of these parts. The cylinder, shown in section, is provided with two flanges, one of which has a register turned upon it. The piston, however, follows ordinary automobile practice excepting that it is curved instead of straight.

On account of having only a limited number to make it was obvious to us that very little could be allowed for special tools and equipment.

After very careful consideration I de-

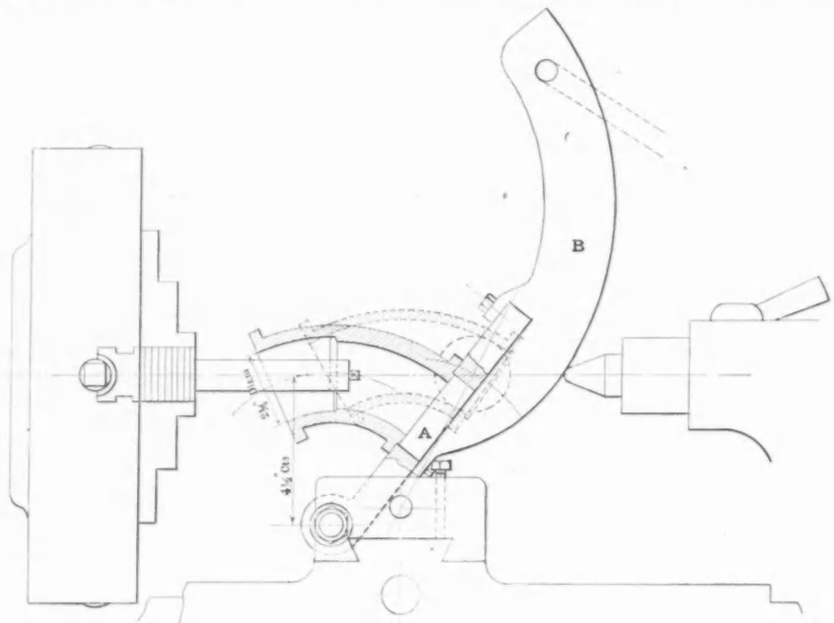


FIG. 1. PRINCIPLE OF BORING SMALL CURVED CYLINDERS

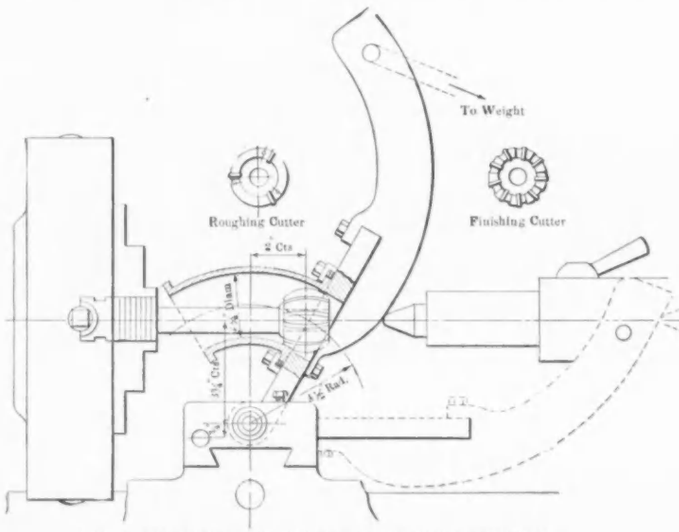


FIG. 2. TOOLS FOR BORING SMALL CURVED CYLINDERS

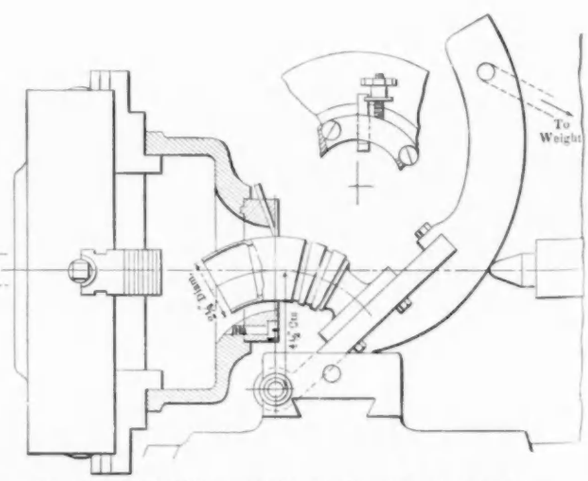


FIG. 3. TOOLS FOR TURNING SMALL CURVED PISTONS

cided upon the following method as being, perhaps, the easiest to rig up and requiring the fewest special tools. The results obtained were satisfactory.

An ordinary lathe of about 7-inch centers was selected. Fig. 1 shows the principle of rigging up. The cylinder was first faced and registered in a lathe by means of two angle plates and then fastened on to the central hinged plate *A* by four clips. Two cast-iron blocks were machined to suit the cross-slides of the lathe saddle—the top rest was removed—and were bored as shown for a spindle, upon which this hinged plate worked. This gave to the cylinder the necessary circular motion. The feed for boring was obtained by advancing a flattened center in the footstock which pressed against a shoe piece *B*. The shape of this piece was approximately an involute. In order to keep all taut and to prevent chattering, a weighted rope passed through the shoe and over pulleys, to a position underneath the lathe.

This arrangement gave all that was necessary for machining because the plane of the revolution of the tool is radial with the axis of the hinge, the distance from center to center is the required radius, and when the cylinder is fed forward one obtains a radial hole. The diameter is governed by the tool. This is shown in full lines in Fig. 1, but as one readily observes, it is only possible to bore this half way down on account of the cylinder fouling the bar.

The remedy for this is not at first sight apparent, because it is impossible to vary the position of the cylinder or tool as one would then obtain an elliptical hole instead of circular.

Suppose we had a finished piece and placed in it a sphere or ball of the same diameter. It would necessarily touch in one of these radial circles, because the plane of contact must be radial and the line of contact also a circle of this sphere. This is the key to the whole principle. The tool was replaced by a spherical cutter, shown dotted in Fig. 1, at the same time the hinged plate was lifted up to fulfill the condition that the distance from the center of the tool to the axis must be equal to the required radius of curvature. Fig. 2 shows a piece nearly bored in which one notices that the centers are 3¾ inches vertically and 2½ inches horizontally, making 4½ inches as the actual center distance. The cutter heads are shown, one for roughing and the other for finishing. The former consists of three cutters or blades held in a mild steel blank; the diameter being 2.24 inches. The latter is similar but of the size of the finished hole, 2.25 inches. These heads were turned with the blades in position, backed off, etc., and the blades ground finally in their proper place after hardening.

The machining of the pistons was comparatively easy. Fig. 3 shows one in position. The cutting tools were exactly above the axis of the plate and 4½ inches away, which was the required radius of curvature. The cutters were held in a cast-iron flange, shaped to give the necessary clearance for the piston when all of it was inside. The pistons were provided with a flange on their upper end which was located upon the plate after the manner of the cylinders. A tool of correct width was fed in to form the grooves, after which a parting tool nearly parted the flange, at the same time facing the top. By these methods piston rings were made also, and it was found that the boring and turning of the cylinders and pistons were accurate to 0.001 inch both for being round and of correct radius of curvature. The half-tones Figs. 4, 5 and 6 are from photographs taken at the time of performing the operations.

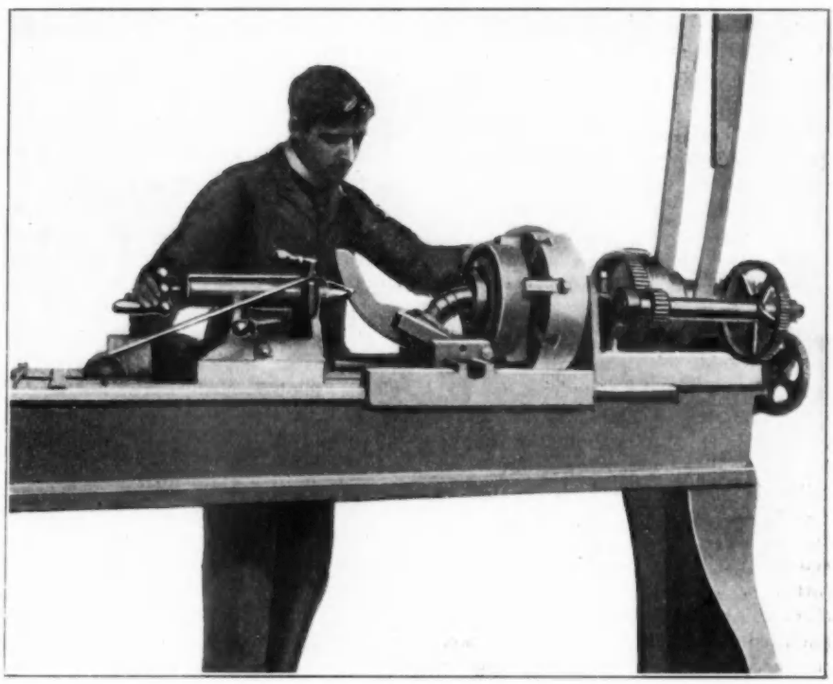


FIG. 6. MACHINING SMALL CURVED PISTONS

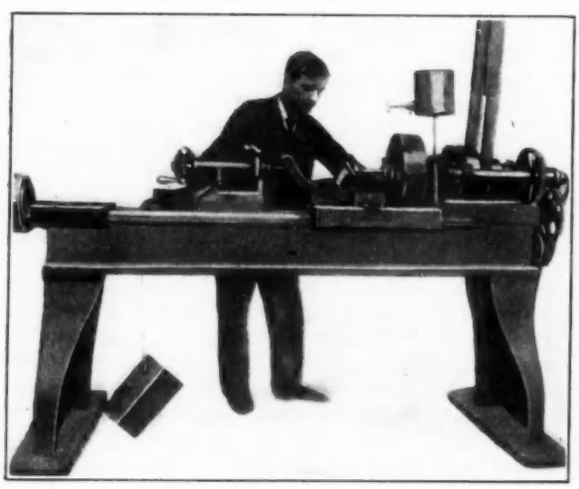


FIG. 4

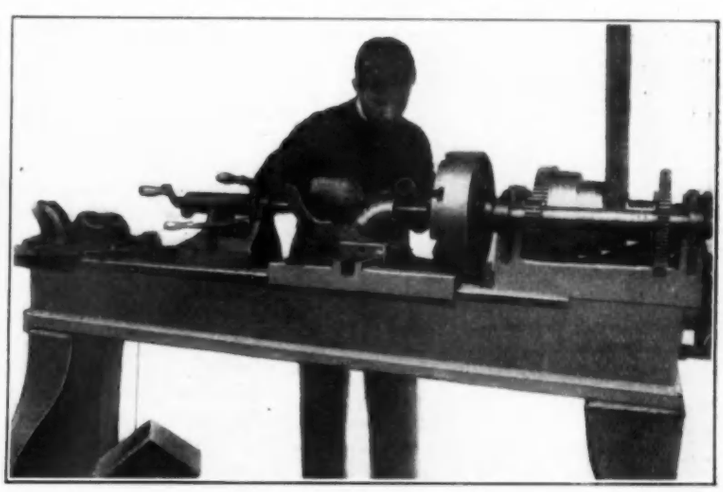


FIG. 5

MACHINING SMALL CURVED CYLINDERS

The Rapid Handling of a Large Pay-roll

$150,000 Are Put up in 11,000 Envelops in Two and One-half Hours and 11,000 Employees Are Paid off in 20 Minutes

BY GEORGE FREDERIC STRATTON

The problem of paying off 11,000 hands without causing any interference with the regular operation of the works, and at the same time with the smallest modicum of inconvenience or delay to the men, is by no means a small one. The method in use at the Lynn plant of the General Electric Company is remarkable for its celerity, smoothness and satisfactory accomplishment. In the five hours between 7 and 12 o'clock every Saturday, $150,000 are divided into nearly 11,000 sums and placed in numbered envelops. At 20 minutes past 12 o'clock every employee has received his money, has given a receipt for it, and is on his way home. Except in the foundries the plant is not operated on Saturday afternoons.

In order to understand the method clearly it will be necessary to briefly describe the plan upon which the pay-roll is made up. Of course regular time books are kept under a check system which records the working time of the piece-workers as accurately as that of the day-workers. In addition to this there is a time-card system for the day-workers. The form used is shown in Fig. 1.* Every day-worker is obliged to hand to his foreman each night one or more of these cards showing exactly the time at which he commenced and finished the job, or jobs, upon which he has worked during the day. Workers on production, construction, or expense must also turn in these time cards; whether they be on foundry work, machine work, driving a team or sweeping a shop. Early each morning these time cards, O. K.'d by the foreman, are sent to the paymaster's department; the time claimed upon them by each man is compared with the time recorded on the time-book; if correct, the time-book record stands. If there is any discrepancy notice is at once sent to the foreman and correction made without delay.

The piece-workers' accounts are sent in upon the form Fig. 2. Each separate job or operation is entered upon a separate slip. On Monday these piece-work slips for the preceding week are in the paymaster's office. They are at once assembled under the workman's numbers, the piece-work prices are checked and the amounts due entered upon them. The bunch for each man—which may consist of 1 or 20 slips, according to the variety of operations he has been engaged upon—are then clasped together by a machine and the total of the amounts is entered upon the top slip of the bunch; thus showing the earnings for the week.

We now have the time-books showing the number of hours credited to each day-worker and authenticated by the time cards, which are really vouchers; also the slips for each piece-worker figured, checked and showing the total due to each man. All of these credits are now entered upon the pay-rolls. The next step consists in making out the pay checks which, as shown by the form Fig. 3, are really receipts. This stage of the work is completed about Wednesday noon. The checks are then sent to the department foremen and distributed to the hands. If

Thomson-Houston Electric Company

Workman's No. 190

Name .....

Order No. ..... Part .....

.....

Commenced .....

Finished .....

Hrs. ..... Amt. .....

FIG. 1. FORM OF DAY WORKER'S TIME SLIP

any errors are reported early on Thursday morning they are corrected at once; if, however, delay occurs in reporting errors the correction is made the following week. The important point is that after Thursday noon the pay-roll must stand as it is then written.

The amount of detail work up to this point is very great. The average number of time cards for each man is three daily; the average number of piece-work slips is six weekly. In all, a total of over 100,000 of these memoranda (vouchers really) have to be figured, checked and totaled each week. Added to this are 11,000 pay checks to be filled out and compared with the pay-roll entries. There are also 11,000 envelops to be numbered; upon each of which the amount due must be written, and these are also carefully compared with the pay-roll.

On Friday the pay-rolls are footed, the footings being checked by three separate clerks. On that day also a schedule is prepared of the denominations of currency which will be required for paying off. This schedule is sent to the bank early in the afternoon and the money called for is put into packages ready for the next morning. Seven o'clock on Saturday morning finds the paymaster and his clerks in their office ready for five hours of the toughest hustle that any man in this great plant has to endure. In two autos the party, consisting of the paymaster, three assistants and two police officers, proceeds to a down-town bank where, by special arrangement, the cashier is on hand to give them the money. At 7:45 they are back in the office with $150,000 in currency in bundles and bags.

"Putting up" the Money

Everything is ready. At five plain, wooden tables are seated 20 clerks; their coats and vests are discarded and their shirt sleeves are rolled up. The first step is to check the bank's delivery. As but few bills of a higher denomination than $10 are used, and an immense quantity of change is required, this counting is no light matter. Bundles and bags are distributed among the tables, are torn open feverishly, and the contents are counted and checked with the package marks. About 40 minutes are occupied with this checking and then the real work of "putting up" commences.

At each table are four men. Before the first man are piles of bills of various denominations and fractional currency. At his left hand is a tray containing the pay envelops; each one is numbered and marked on the outside with the amount due to that number. This first man counts out the amount called for and slides it, together with the envelop, to the second man. He in turn counts it and passes it to the third man who, after counting it, pushes it over to the fourth clerk who puts it into the envelop. Each amount is thus counted three times. In one corner of the room is the paymaster ready for any emergency, or to relieve any man. He keeps his eye constantly on the piles of money, ready on the instant to toss over a bundle of fives, or ones, or a shovelful of quarters or nickels. Not a word is spoken except an occasional call of "tens here!" or "pennies here!" As the men warm up and strike their gait the work goes along with automatic steadiness and great speed. Eight-thirty is the schedule time for commencing the actual work of "putting up" and eleven o'clock is the time to finish. Two and one-half hours to distribute over $150,000 among 11,000 different amounts! Over 2200 accounts to each table, of which each man has to handle or check one every four seconds!

Marvelous as is this long stretch of continuous speed, it very seldom happens

Note—The Lynn plant of the General Electric Company was formerly that of the Thomson-Houston Electric Company. For purposes of distinctive shop accounting the old title, T. H. E. Co. is still used upon all shop forms.

that any errors occur. The pay-roll is divided into 10 sections and as the paymaster delivers the requisite amount for each section in rotation, and that section is cleaned up before the next is commenced, any error is at once shown in and confined to its particular section. If an error does occur and is but a small amount—a dollar or two—it is allowed to pass. It will probably be reported by the workman. If, however, it amounts to five or ten dollars a recount is required; it is a tired and disgusted crowd who, after 11 o'clock, settle down to go over that section again. In the year just passed it is stated that a recount has been necessary but once, although there was an occasion which caused every man to look gray for a few minutes. Toward the close of a session the paymaster called a halt. He was $500 short! There was consternation while schedules were rapidly checked over without result; then a hasty search through the room for a missing bundle; then the paymaster dropped into his chair and pulled the 'phone toward him.

"Central, give me the ——— bank."

"Hello, Mr. ———! This is the General Electric paymaster. Did we take all our packages this morning?"

"No! You did not. There's $500 in 'two's' here. I've been trying to notify you, but could get no connection."

Here was relief; three minutes later a clerk was in one of the company's auto's, speeding for the missing package.

During the time of handling this money the pay office is locked against everybody; even the general manager will turn back if he inadvertently tries the door. The telephone is cut out; the shop central having strict orders not to connect anyone under any circumstances. This is why the bank cashier was unable to communicate with the paymaster.

After the money is "put up" there are a few minutes in which the clerks can stretch cramped limbs and get a glass of water; then the hustle recommences. As the pay envelops were filled they were deposited in tin trays, which in turn were slipped into heavy zinc boxes, each box holding all the envelops for one of the 10 stations. It must be understood that at 11 o'clock the entire amount is distributed into these 10 boxes. Each box is now taken by two clerks, who count the number of envelops which it contains. This result is compared with a schedule taken from the pay-roll. If correct the clerks give the paymaster a receipt for that number, lock the box and the senior of the two pockets the key. Thereafter he is responsible for the contents.

During this hour a regular and exasperating duty falls upon the paymaster. It is at this time that trustee writs and assignment notices are served upon him. As there are never less than 12 and perhaps 20 of these the boxes have to be unlocked and the trusteed pay envelops taken out, thus involving a correction of the clerk's receipts. Also, in order to avoid confusion at the pay stations, the men who have been sued are notified over the shop telephones. This company has never been severe with men whose accounts are thus troubled, unless a continuous disregard of obligations is evident after a man has had ample time to adjust his affairs. The present paymaster ungrudgingly sacrifices much valuable time in explaining to these delinquent debtors their standing under the law and giving them wholesome advice for extricating themselves from their embarrassments.

Paying Off

At 15 minutes before 12 o'clock 10 husky workmen are assembled in the corridor. The paymaster calls out, "All ready, boys!" and they file up to the door where each man is handed one of the heavy zinc boxes, which he carries to its proper pay stations, accompanied by two clerks. These pay stations are small, wire-enclosed cages with a shelf and opening. They are built at such points in the plant as will be most convenient for the assembling and exit of the workmen. The senior clerk locks himself inside and arranges the small trays of envelops in proper order. The junior clerk is stationed outside. A line of workmen is already formed and, as the noon whistle is heard, the first man steps forward, hands his pay check to the outside clerk, who sharply glances at the signature and calls out the number. The corresponding pay envelop is instantly passed out to the man.

It is interesting to watch this proceeding. Everything is scaled down to the sharpest, keenest systematization that is possible. "Seven thousand and one!" calls out the clerk; then, "Two—three—four—six (five is absent)—seven—eight—nine—hold!—get out of line and sign your check! Come on there!—ten—," and so on. A foreman or sub-foreman stands close by to hustle the men along and, after a dozen or more numbers are called and the regular pace is struck, the line marches past the pay window at a quick stride without the slightest halt. New men very soon see the necessity for keen alertness if they would start for their homes with little delay. The man who hands over a folded check, or who presents it by any other than the particular corner which will enable the clerk to instantly see the number and the signature, is liable to get a jolt from the fellow behind which he will not readily forget. The whole plan is military in its conduct and discipline; the result is seen in the fact that at the station where the greatest number (about 1200) are paid off the record time is 18½ minutes, or a little over one each second. Men whose pay checks are handed in unsigned are unceremoniously hustled out of the line and lose their place. They come up after the whole line is paid off and then get their envelop. If a man finds the amount in his envelop incorrect he proceeds at once to the paymaster's office and reports.

As soon as the line is paid off the clerks return to the office. Here they count all the checks they have received and the envelops which have not been called for. If this count corresponds with the receipt they gave to the paymaster their work is ended; in a few moments they are also on their way home.

Possibly among the debris left on the office floor will be some copper or silver coins. In the rush of "putting up" a dropped coin is disregarded except for a cry from the clerk: "Quarter on the floor!" or "Half-dollar dropped!" The work cannot be stopped for an instant to reclaim them. In the afternoon the janitor sweeps up and any such stray coins will be found in an envelop on the paymaster's desk on Monday morning. It is the opinion of the paymaster that none of them ever get away.

Outside of the works a quarter-mile of

COMPLETED WORK SLIP
Thomson-Houston Electric Co.

West Lynn, Mass., ____ 190__

No. ____ Name ____

List ____ No. ____ Order No. ____

Part No. ____ No. Completed ____

Oper. No. ____ Price { each ____ / per 100 ____

Operation ____ Amount

Grand Total

PIECE WORK COUPON

Classification ____

Order No. ____

Employees No. ____

Date ____

Amount - - -

FIG. 2. FORM OF PIECE WORKER'S ACCOUNT SLIP

IF AMOUNT IS NOT CORRECT REPORT TO OFFICE at once

No. ____ West Lynn, Mass., ____ 1

____ Received

DOLLARS | CENTS

of THOMSON-HOUSTON ELECTRIC CO

in full for services to and including ____ 1

Name (with initials) ____

FIG. 3. FORM OF PAY RECEIPT

sidewalk adjacent to the ten exits is strewn with thousands of discarded pay envelops, often torn into shreds. At 1 o'clock a solitary helper appears and puts in a steady afternoon's work in sweeping these walks and gutters. The cleanest, neatest streets in Lynn on Saturday evening and Sunday are those surrounding this plant.

Standard Hardness of Steel

By W. H. Fleet

In regard to the article by James Steele, on page 898, Vol. 30, Part 2, "Standards for Hardening and Tempering," in which he states that, as to the change in sulphur and phosphorus, by selecting a few bars at random from a lot of steel and testing a few pieces this can be regulated very easily in the tempering.

The writer's experience of over eleven years in a steel mill devoted to the manufacture of crucible and alloy tool steels, and having had the complete analysis of every piece experimented with, has never been able to detect the difference of the small amount of sulphur or phosphorus in the same grade of steel. When we consider that in a steel suitable for reamers or milling cutters it will only vary about five one-thousandths of 1 per cent., on an average, in any of the standard grades of steel, and the slight difference is only detected by the chemist and would not affect the hardness or toughness of the steel, and when we also consider the extreme care used by the steel mills in grading and inspecting their material, they certainly would not risk their reputation by letting steel go out for expensive tools that was high enough in either sulphur or phosphorus to be detected in the hardening.

In regard to the hardening of a thin piece of steel, or one of considerable bulk, of the same analysis, he should have made it plain that the forcing should not be done in the heating, as the large section should be heated to the same heat as the small one, the only difference being that the small one would harden clear through, while the large one would only harden in a certain depth, which depth could be increased by increasing the action of the bath, as the proper tempering heat for a given analysis always remains the same.

His method of getting a standard for hardness, in which he uses eight test pieces, and hardens eight tools at the same heat as the test pieces, and after the tools are worn out, breaking and comparing the fractures with the test pieces, this method would not be required if the hardener was using a pyrometer, as he could make a record of the heat given each test piece, and by breaking and inspecting the fractures tell which was the right one. But for any man to attempt to get eight different heats, from the point where the steel did not harden file hard to the point where it would show overheating, and retain those eight different heats in his eye or brain for a number of days, until the tools were put out of commission, would be an utter impossibility.

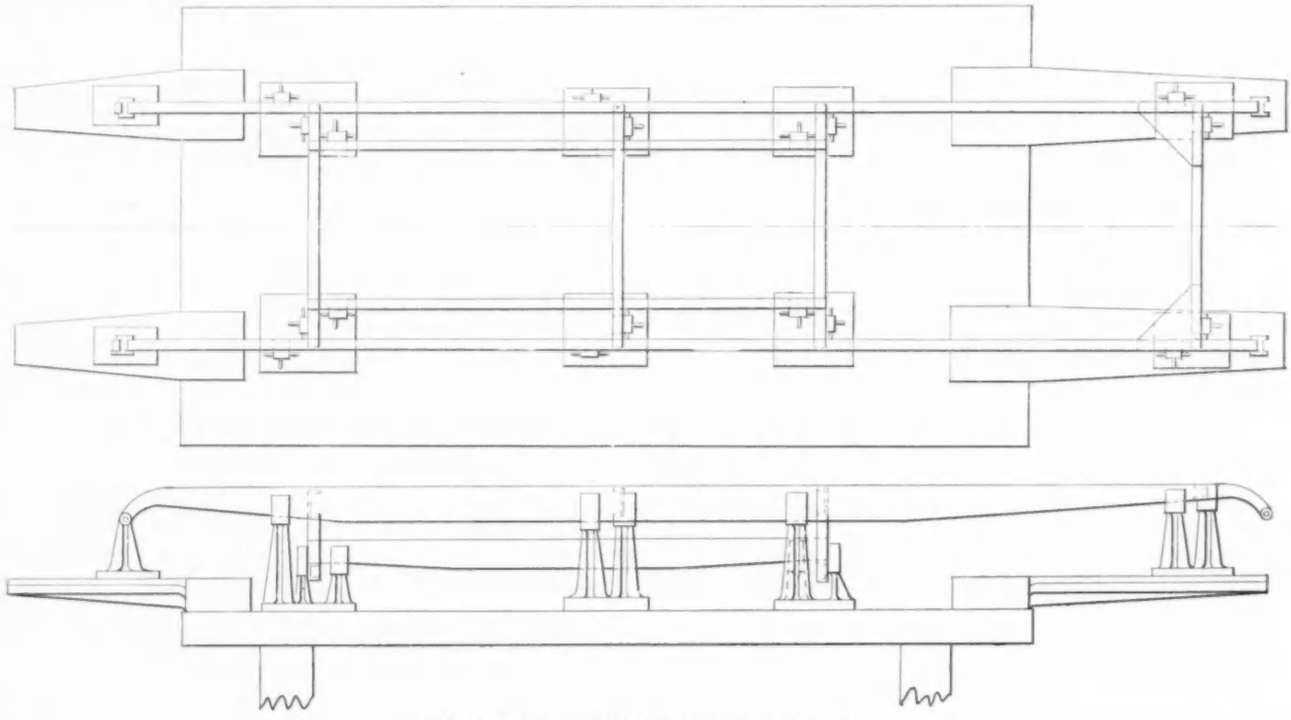
The method used by most temperers, when they get a steel that they are not familiar with, is to make four or five nicks in the end of the bar and heat the extreme end until they consider it will show a slightly overheated fracture, harden, then break off the pieces and examine each one from the overheated one to the last fracture on the bar, which should show some of the natural fracture, and try to get their heat as near as possible to the piece showing the best fracture.

Assembling Fixtures for Automobile Frames

By C. A. Erickson

Where automobile frames are assembled in quantities, a fixture for locating and holding the various members while riveting is indispensable.

A fixture for this purpose should be so designed as to locate all parts of importance, as well as establish the width of the frame. A fixture similar to the one shown has given good service for a long time and a great number of frames have been built on it.



FIXTURE FOR ASSEMBLING AUTOMOBILE FRAMES

The fixture consists of an iron table high enough to allow the men to stand nearly erect while performing the work. This table should be wide enough to take in the widest frame, so that the same table can be used by making new locating brackets to suit each frame. The table may be made long enough to take in the entire length of the frame, but this will make it very heavy; and the whole fixture will also be more accessible if extension arms are used at the ends as shown.

Some T-slots should be provided in the

table, which will allow of sliding the extension arms and brackets to suit various conditions.

The smaller brackets for locating the various members should be so designed that free access and ample room for riveting are provided.

It is good practice to locate the side channels fore and aft by placing the spring eye over a bracket and then slipping a pin through both. The side channels should then be located vertically and crosswise by bringing them against the locating surfaces and applying substantial C-clamps at all locating points. The subframe (if the construction is such) and cross-members may now be secured in a similar manner, and drilling and riveting may be started.

Shipbuilding on the Tyne

By J. W. Carrel

The shipbuilding industry is quite dull at present; less than 50 per cent. of the normal volume of business is being done. No new contracts are being let because of the high rate of money. A large percentage of vessels are built on borrowed capital, which must not cost over 3½ per cent. per annum in order to insure a profit on the venture. Therefore, with money at 7 per cent. a prohibition was placed on all new contracts. Yet as money has now been reduced to 4 per cent., with a probability of soon reaching 3½ per cent., there are prospects of a number of good orders which are cheering the shipbuilding yards.

The success of the "Lusitania" and "Mauretania" will force the other Trans-Atlantic lines to follow in the lead of the Cunard and build turbine steamers to compete with these two great vessels. This fact is shown by the Atlantic rate war of the last few weeks, in which the other lines claimed a differential rate over these two fast liners. Undoubtedly they are getting the lion's share of the business and will continue to do so, differential rate or no differential rate, until other vessels of their class, or better, are built to compete with them. The building of such vessels will mean an enormous amount of business for the shipyards at no distant date.

Tyne Yards Pleased with the Mauretania

Of these two sister ships, the "Mauretania" was built on the Tyne and the "Lusitania" on the Clyde. Heretofore the first-class ocean liners have been built on the Clyde. The Tyne shipyards built men-of-war, freighters, tramps, and second-class passenger vessels. The "Ivernia," a 15-knot ship and so second-class in speed, not, however, in workmanship or material, was the biggest which they had produced.

In placing the orders for the "Mauretania" and "Lusitania" a number of points were left to the discretion of the builders, subject to ratification by all of the various parties concerned; which were, the British Admiralty, the Cunard Steamship Company, Limited, the Parsons Marine Turbine Company and the builders. The interest of the British Admiralty is shown by the fact that they loaned £2,600,000 at 2¾ per cent. interest to be used in the construction of these vessels, and gave an additional subsidy of £150,000 annually in order to secure the right to the services of these vessels as auxiliary cruisers in case of war. Now that the "Mauretania" has broken all records, her builders and the furnishers of her materials claim that it is due to these points upon which they were allowed to exercise certain options, which have enabled her to beat her sister ship. The more particular points to which they refer are in the construction of the rotors and other essential parts of the turbines.

Naturally, the shipyards on the Tyne are very jubilant over her victory and are looking forward to getting a large proportion of the contracts for first-class liners which are to be let in the future. They feel that they have thoroughly demonstrated their ability by building the "Queen of the Sea" on the North-East coast.

It is somewhat remarkable to consider the length of time consumed and the great thoroughness of design in building these ships. However, after the data were completed they were pushed through with celerity to a successful finish. The subject of building them was first broached in 1901, but moved along very slowly until 1903, when decisive steps were taken and a commission was appointed for research and experiments. As they were to be so much longer and to have a speed so much greater than that of any large vessels yet built, and because of the turbine drive with quadruple screws, there were no data at hand to apply to the details of their design. Again, the depth of harbors and docking facilities had to be taken into consideration. In studying the design the ships were compared with a girder, and stress diagrams were worked out to cover all possible conditions. After the builders of the "Mauretania" had experimented with towed models they built a power-driven model 1/16 the size of the finished vessel. Experiments were carried on with it during a period of about two years. The information thus obtained covered all possible points of design and gave authentic knowledge of what could be expected from a vessel developed along the lines contemplated.

The Wallsend Shipyard

The Wallsend shipyard, where the "Mauretania" was built, is in the eastern portion of Newcastle-on-the-Tyne, on the site of an old Roman fortress, Segendunum, which existed about 280 to 400 A.D. During the laying of the keel of this vessel a part of the old Roman walls was unearthed. This yard covers an area of 78 acres, with a river front of 4000 feet. Sixteen vessels can be built here at one time; in addition to their necessary building berths there are two floating docks and one large dry dock. In 1906 the tonnage launched amounted to 127,000 tons. After the "Mauretania" contract was received they built a new building and installed new machinery, among which was an Armstrong, Whitworth & Company lathe 108 inches in hight of centers, weighing 280 tons and driven by an 80-horse-power motor. Heavy multiple punching presses, bending rolls, shears, plate planers, hydraulic bending presses, etc., were also installed. Two new building berths were made, 95 feet and 100 feet wide, respectively; each 750 feet long. They are covered with glass roofs so that work can be carried on during stormy weather and in winter. From each roof are hung seven electric traveling cranes from three to ten tons capacity. In addition to these they built a most powerful floating crane, capable of lifting 150 tons. This crane can be propelled by its own power to any part of the river. In addition to all of this special construction work it was necessary to dredge the river.

The period of building called for from the time of signing the contract to the date of completion was 30 months. This stipulation was more than met, as the builders were able to make delivery one month prior to the stipulated date. Her general dimensions are, of course, well known, but still they will bear repeating: Length over all, 790 feet; extreme width, 88 feet; draft, 33 feet 6 inches; gross tonnage, 33,000 tons; horse-power, 70,000. The contract average speed was 25 knots. On her trial trip this was exceeded by 2.36 knots, a speed of 27.6 knots having been maintained from Corsewall Point to Longships.

Machine-tool Prospects

In general the machine-tool business is improving; that is, inquiries have been coming in since about January 15. In the automobile field there is very little buying of new machinery; nor is this to be expected until business conditions in America become more settled. After conditions in the shipyards become straightened out, due to easier money conditions, there should be an excellent field there for American machinery and machine tools.

Newcastle-on-the-Tyne, England.

Alzen is the name given to a new metal, which is composed of two parts of aluminum and one part of zinc, writes Consul-General Guenther from Frankfort. It is said to equal cast iron in strength, but is much more elastic. Alzen is superior because it does not rust as easily as does iron and it takes a high polish.

Four Styles of Work Benches

The work bench receives very little attention in too many shops and anything that will hold a vise is allowed to pass muster. The duties of a bench vary with the shop in which it is located according to the work that is to be done on it or at it. If it is simply a filing bench, the main requirement is that it support a vise firmly and at the proper hight. If an assembling bench, these are not the important features, and just what it does need depends on the kind of work being handled.

But for the average shop work we want a bench that is rigid; that will stand chipping and filing; that can be used in testing work on a surface plate or in handling jigs and fixtures; that will not splinter badly nor yet injure a tool should it happen to drop on it. For the toolmaker the cast-iron bench top has many advantages, but both the bench and the tool are very liable to be marred by dropping the tool on it, so that for general use we rely on wood as in the days of old, except that we soon find from the purchasing agent or

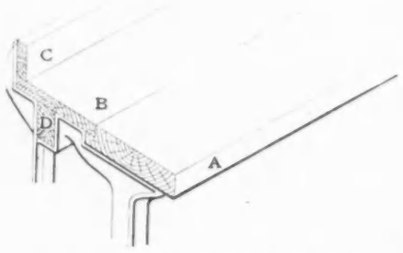


FIG. 1. GOOD FOR ORDINARY WORK

otherwise, that timber is higher than it used to be and that a bench with solid 2- or 3-inch planking the whole width is too expensive to consider. Then, too, we no longer want the bench braced up against the wall because steam pipes have taken the place of the old stove and the best place for steam pipes is on the wall back of the bench. So we set the bench out from the wall to allow the heat to rise and the air to circulate, as well as giving the sprinklers a chance to get at a fire on the floor near the walls.

The pioneer in the cast-iron bench leg that could be called a standard was probably the Brown & Sharpe Manufacturing Company and many shops are using their bench legs in various parts of the country and their design allowed either the full thickness of plank both back and front or the use of a lighter board at the back, as was deemed best for the particular case in hand. The use of a lighter board at the back has become so common that the New Britain Machine Company's design for a bench leg is made for this construction as shown in Fig. 1. This also shows the back board *B* rabbeted to the plank *A*, which supports it all along the front edge, and it is also supported by the stringer *D*, which runs the whole length of the bench. These supports, in addition to the cross bearing of the legs every 6 or 8 feet, give the back board a stiffness that was unknown where they are simply laid flush and not rabbeted and the stringer is absent.

Benches made without these supports are open to the serious objection that the

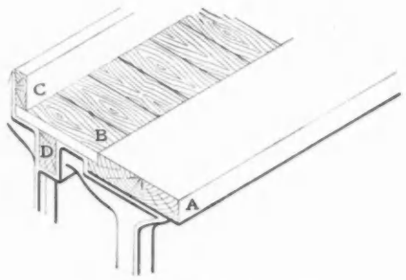


FIG. 2. ANOTHER METHOD

back board springs down when a heavy weight such as a jig or surface plate, is put on the bench and throws them out of level.

All cracks are more or less of a nuisance in bench work, but in this case any shrinkage can be taken up by wedging against the iron support of the board *C* and the edge of the back board *B*.

Another style bench with this same leg is shown in Fig. 2. Here the front plank *A* and the back board *C* are the same as before, but instead of having one back board, this part of the bench is made up of narrow strips as *B*, fitting into rabbet in plank *A* and supported by the stringer *D* as before. These narrow boards can be either tongued and grooved hardwood flooring, or can be square edges, as preferred; in either case any shrinkage can be taken up by forcing the boards together.

A cheaper form of bench is shown in Fig. 3, where the heavy planking is en-

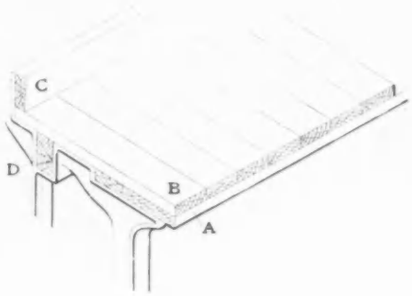


FIG. 3. A CHEAPER WAY

tirely dispensed with and the boards *B* run the full width of the bench as shown. Running along the front, underneath the main boards is a soft plank *A* which supports the edge of the bench where the most work comes, and under the back is the 2x6-inch stringer as before. Here, too, the boards can be either notched or square edge, each having its advocates; the objection raised against the tongue and groove being that the edges are apt to split off from heavy articles dropping on them. An advantage claimed for the boards running this way is that work going on or off the bench is always in the direction of the grain of the wood and that fewer splinters are formed on that account. In either Figs. 2 or 3 any local wear can be remedied by replacing the worn board with a new one. Some object to the end of the grain at the front of a bench.

The material used in any of these can be varied to suit the individual requirements, fancies or pocketbook. Maple is generally considered the best wood for a bench, while others prefer ash. For the back boards hard pine is often used and even cheaper woods will answer if necessary, although it probably pays to use maple all through if you can stand the pressure at the time you need the bench.

Still another style of bench is shown in Fig. 4 and one which was designed to be serviceable and have a long life without so much regard to first cost as some shops must exercise. The bench leg was flat on top, the first layer of maple planks *A* and *D* and on top, narrower boards of the

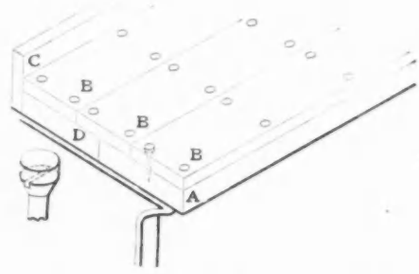


FIG. 4. A GOOD BUT EXPENSIVE CONSTRUCTION

same material. These were fastened with long wood screws, holes being countered and plugged as shown.

The theory of this construction is that the boards are sure to be more thoroughly seasoned than the planks, consequently the planks will shrink the most and tend to draw the top boards closer together. It certainly makes a solid bench, but the first cost is rather high.

Benches are also occasionally built up from small blocks so as to present an end grain on the top, the same as butchers' blocks. One shop we know of surfaces these when worn by putting them on a Daniels' planer and substituting a circular saw for the swinging knives. This saws the top very smooth and leaves a good surface. Others glue up strips on edge and plane down to a smooth surface so as to do away with all cracks. Zinc or even heavy paper covers are often used where fine work is being assembled to prevent its finding its way into cracks and crevices.

The usual work bench is from 33 to 35 inches from the floor to the top, about 29 or 30 inches wide and has the front plank 3 inches with back boards 1 inch thick. A cast-iron leg of this type weighs about 50 pounds.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Three-piece Roughing Reamer and an Adjustable Countersink

A very satisfactory roughing reamer for roughing out the cored keyhole in brass valves and cocks is shown in Figs. 1 and 2. Where scrap brass is used to any extent in the foundry, the resulting castings are sure to have spots of iron in them. A cheap roughing reamer that will stand a great deal, that can be easily sharpened, that can be kept to size and the blade of which can be easily and quickly replaced when worn out, is a positive necessity for profitable work; such a reamer is the one shown.

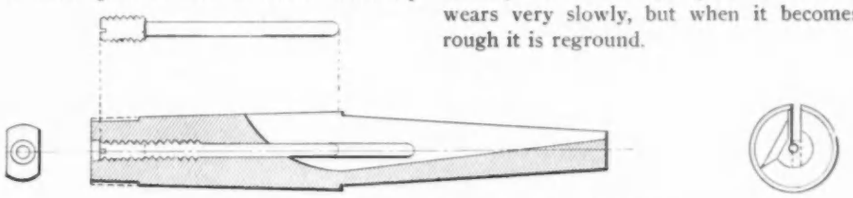


FIG. 1. SECTIONAL VIEW OF ROUGHING REAMER

The body of the reamer is made of tool steel and is turned 0.010 oversize; the center hole is drilled and then tapped for an inch or more according to the size of the reamer. The flat parts and slot are next milled; the body is then hardened and ground to exact size and the slot lapped out in order to eliminate the warping and closing in due to hardening.

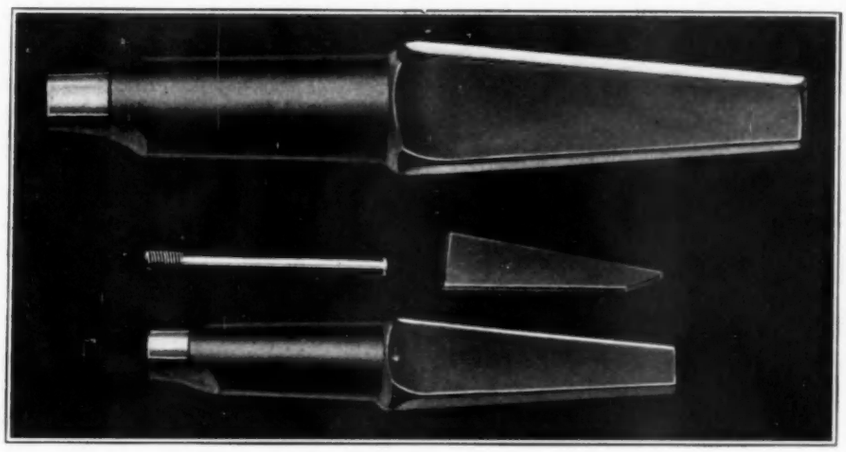


FIG. 2. THE ROUGHING REAMER

The adjusting screw is made of tool steel, hardened on the end which comes in contact with the blade.

The blade itself is made of high-speed steel hardened and ground so that it is a tight fit in the slot. As the tendency in cutting is to hold the blade in place, nothing is needed to lock it. As the blade dulls, the adjusting screw is advanced slightly; this shoves the blade out, and it is then reground. When the blade is worn so much as to make further grinding useless, it is pried out by putting a screwdriver under the bevel on the bottom of the outer end of the blade. The adjusting screw is then screwed back and a new blade put in. The taper part of the body wears very slowly, but when it becomes rough it is reground.

After the scale and most of the stock are roughed out of the valve body, the hole is finished with a regular standard fluted taper reamer.

Where considerable countersinking is to be done, a countersink that will fill every requirement is shown in Fig. 3. It consists of five parts: the body, the blade, the adjusting collar, the grinding collar and a set-screw.

The body is turned a trifle large and the blade slot milled. It is then hardened and ground. The guide collar is merely made a close fit and slipped into place. The blade is made of high-speed steel and is easily replaced when worn out.

The general construction is plainly shown, and no further explanation is needed, except that the adjusting collar and set-screw are of tool steel and the guide collar of machine steel.

Decatur, Ill. ETHAN VIALL.

Technical Graduates and the Machine-tool Trade

Every little while someone asks, "Why do not more technical men go into the machine-tool business?" Having been in it, perhaps I can make a good guess. In the first place, there are a few in it and, so far as I know, leaving out myself, of course, they are doing well. That is, they are doing well compared with others in the same business. As compared with others with whom they were in school, they have not done well. That is, there is not much money in machine tools for a man with an engineering education.

The question arises as to what a technical man does when he goes into a machine-tool shop. Most tool builders expect that he will go into the shop and learn to be a machinist. They show about as much knowledge of what a technical college is as did a lady friend of mine who confided to me that her small boy showed plainly enough that he never would make a scholar, so she was going to send him to the "Tech." I told her that he would find that it takes more of a scholar to get through that particular technical school than through any college in the country, but she did not believe me. Nor will the machine-tool men, nor anyone else. It is more work to get the parents of a boy who intends going through a technical school to visit that school than the job is worth. They will go up and see him graduate, and they think that the ribbons and bouquets and brass bands are a part of the regular every-day work.

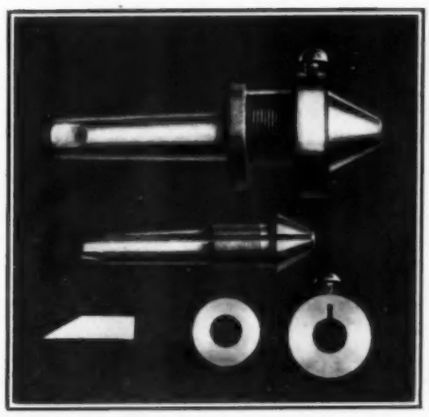


FIG. 3. THE COUNTERSINK

A technical graduate who has had a fair chance at school ought to go into the

shop of his chosen business for a while, but it ought not to be necessary for him to learn the whole trade. A few weeks in the stock room, a few more laying out work, a little while on the setting-up floor, and he ought to be ready to take a productive part in the business; not as president, perhaps, but in a position with some pay attached. But instead of that these fellows generally strike for the drafting room, and there they are of no particular use to themselves or anyone else.

The way in which machine tools are designed is queer to a scientific man. First, the designer collects catalogs and all the data possible as to what other manufacturers make. To do this he culls largely from the AMERICAN MACHINIST. He does this so that he may be sure that he does not copy anything unconsciously. Then he proceeds to add one-sixteenth of an inch to the diameter of each shaft, that has its size printed in the catalog, over and above the largest size given by any competitor. Then he adds some ingenious contraption with a lot of gears and clutches either to feed or drive the machine, and the job is done. When Entropy wrote about designing a boring mill, he struck about the real way even if he did get called down. There is really nothing in the design of machine tools to attract a technical graduate. He cannot use more than the smallest part of his knowledge of mechanics or of strength of materials, and even his machine design, if of a totally different brand.

Now where could a technical man fit into the machine-tool trade? There is a good chance right in the shop, looking after methods of production. The machine-tool trade, more than any other that I know about, is an evolution. That is, it is something in which precedent has a large part. Things are made this way because someone else made it so. Now put a technically educated man in the shop and tell him that his future bread and butter depend on what he can save. He will take each piece and consider logically what its functions are, and how it may best be designed and made in order to perform those functions properly. He will investigate what machine tools are best adapted to the making of certain pieces, and he will go at this without being hampered by a knowledge of how it has been done. Will he get laughed at? Yes, at first; but it won't be long before he can laugh, too, and you know about the old adage that applies. Try him; there is a lot of chance for good to both sides.

Springfield, Mass. INSTRUCTOR.

Another Nice Indexing Job

Your article on page 508, describing and illustrating an indexing job on a boring mill in the Binsse Machine Company's shops, was published at the same time that

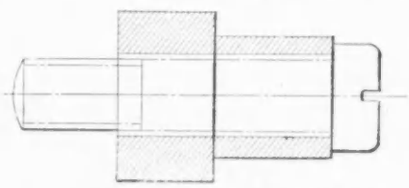


FIG. 2. LOCATING BUSHINGS AND PINS

a very similar job was being bored in the shops I am connected with. As this was being indexed in an entirely different manner, I was particularly interested in ascertaining which would give the better results. The work in question was part of a special machine, only one of which was required; therefore all special tackle for machinery had to be cut down to a minimum.

The photo, Fig. 1, shows the part to be bored; this is a cylindrical casting 29 inches in diameter, encircled by a yoke in halves. The seven holes shown had to be bored 6 inches in diameter and counterbored at the front to 7¾ inches. Not having any horizontal boring mills, the only available machine that could be used for the purpose was a heavy 10-inch center (20-inch swing) engine lathe.

The cross slide was removed and a special plate, of the correct thickness to bring the hole to be bored the same hight as the centers clamped in its place. The yoke was then bolted to this plate by the feet, as shown in the photograph. To get the holes indexed exactly the same distance apart, seven bushes and pins were made as illustrated by Fig. 2. The bushes were all ground to exactly the same diameter and bored 1/16 inch larger than the pins.

Seven holes were then drilled and tapped on the outer edge of the cylindrical casting, to suit the screwed ends of the pins; these holes were marked off as accurately as possible with dividers. The pins were then inserted through the bushes and screwed into the holes, just so tight that the bush could be moved sideways by tapping it. To space the bushes exactly the same distance from each other and from the center, a micrometer head was attached to a bar, as illustrated by Fig. 3, the opposite end being bored just to slip on the bushes down as far as the shoulder. The micrometer was then adjusted to touch the outside of the boss in the center of the casting, this operation being repeated on all seven bushes, spacing them all exactly the same distance from the center.

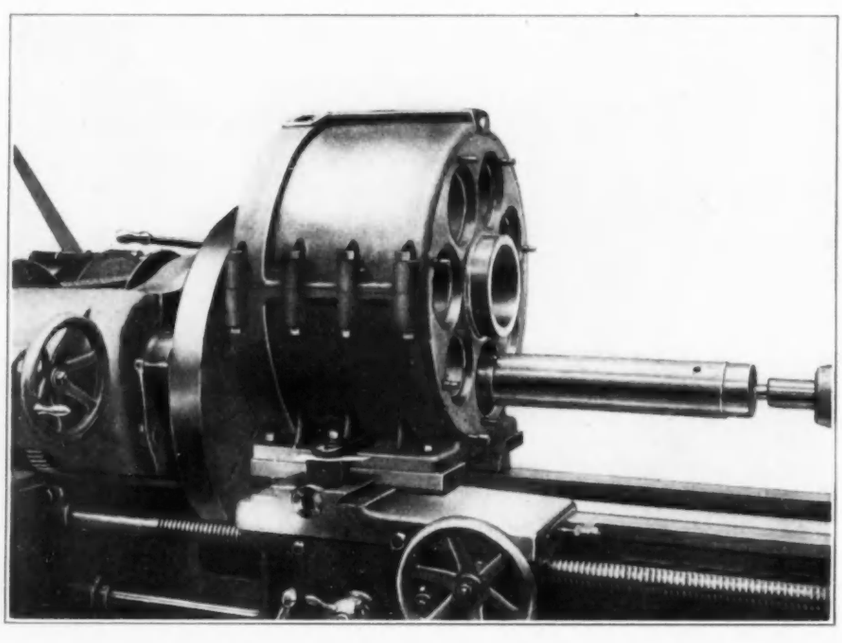
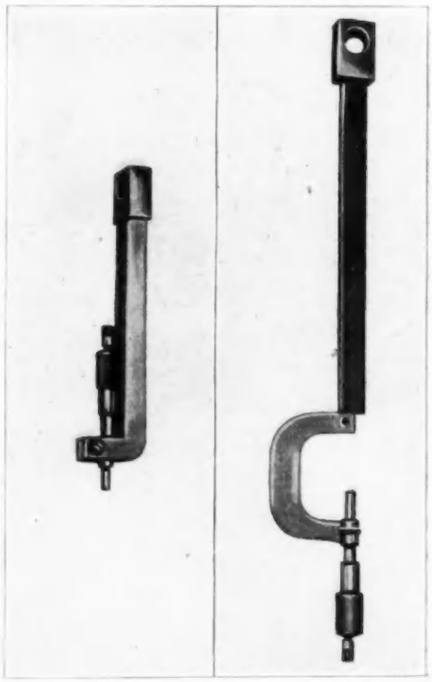


FIG. 1. THE JOB TO BE BORED



FIGS. 3 AND 4. MEASURING BARS WITH MICROMETERS

Fig. 4 shows a standard micrometer attached to a similar bar (a micrometer head could have been used in this case, had there been one available). The bored end was slipped on one bush and the micrometer adjusted to swing by the one next to it. This was repeated on all the bushes until they were evenly spaced round the circle. Of course this was a matter of trial and required some patience which, however, was amply rewarded by the result finally obtained.

It was found that these measuring instruments were so sensitive that 0.00025 inch could be felt, but only when the casting was laid in a horizontal plane so that the measuring instruments when being swung round on the bushes supported their own weight on the shoulders; when the casting was vertical and the measuring instruments had to be pressed against the shoulders to insure their being in the correct position, they were not nearly as sensitive. After setting all the bushes, the first hole to be bored was placed approximately central with the single-point boring bar, which was inserted through the cored hole and fixed between the lathe centers.

The casting was clamped in position by screwing the two halves of the yoke together, this yoke having been bored with a liner between the joints, which on being removed allowed the two halves to act as a clamp. A large-headed pin will be noticed projecting from the bottom half of the yoke; it was used as a locating peg for measuring the distance each of the different holes had to be swung round when they were bored.

After the casting was fixed for the first hole to be bored, the measuring tool, Fig. 3, was slipped on the bush above the next hole and adjusted to the locating peg. When the hole then set was bored, the casting was swung round so that the next bush was exactly the same distance from the locating peg that the first measured, and so on until all seven holes were bored.

By this method it was possible to take roughing cuts on all the holes to remove the scale and reset them in exactly the same position for finishing. The accuracy of these holes was tested by measuring the thickness of the walls between each hole, with the result that they all came within 0.001, which is, I think, remarkable considering the size of the casting and the holes.

No doubt a good many of your readers have had the machining of similar jobs; it would be very interesting to know how they handled them and with what results.

E. W. Richmond.

Gloucestershire, England.

An Emergency Gear Cutting Job

It may be of interest to know how a spur gear of 134 teeth, 2-inch pitch and 6-inch face, was cut in a shop which had no appliances for such work.

The gear ring was to be put on a flywheel of an ice machine so that it could be operated by a motor drive at night. The ring was first turned to size on a boring mill and a six-arm spider bolted to it. Then the hole was bored out true with the outside. It was then put on a large pit lathe and a shaft clamped solidly to the bed of the lathe so that the ring revolved on the shaft. It was then spaced off for the number of teeth and a blanking cutter driven by a worm-geared milling attachment gashed it. A gear cutter then finished it.

The milling attachment was made especially for this job and was driven from a counter-shaft above. The feed was obtained by jack shafts and pulleys fastened to the screw on one of the heads of the lathe having a double thread.

The job was done quite satisfactorily under the circumstances. In Fig. 1 the blank can be seen about two-thirds finished, and the other view, Fig. 2, shows the milling attachment which was bolted to the regular tool post of the lathe.

Seattle, Wash. S. P. Kane.

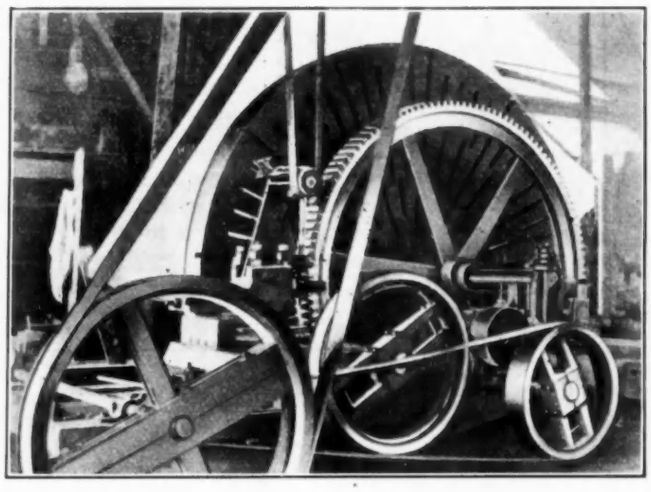


FIG. 1

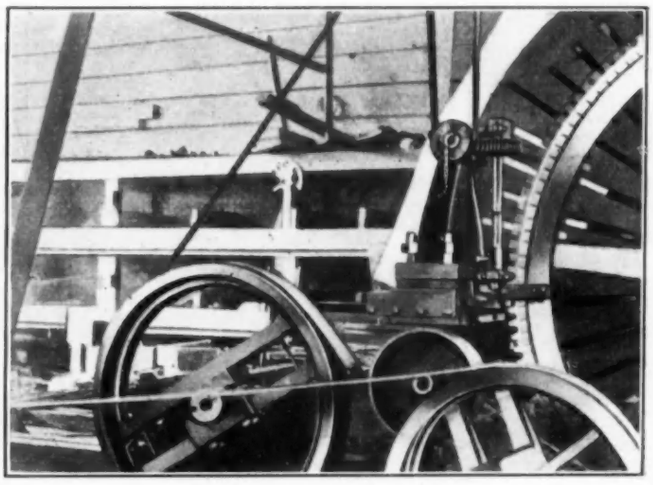


FIG. 2

AN EMERGENCY GEAR-CUTTING RIG

Bolting Down Planers

As an indorsement of Mr. Norton's claim that bolting down planers is a waste of money, I would say that while we have had nothing larger than 48-inch or smaller than 20-inch planers, we never bolted any down; aside from radial drills, there are hardly any iron-working machines that need bolting down.

We have just set a 50-ton machine; as the foundation plan called for a dozen or 20 of 1½-inch bolts, our men put them in. But it was a dead waste of money, as the nuts are only run down by the fingers.

Possibly the builders of the machine could not sell them if they left out the bolts.

We have for years been supplying center-crank engines direct connected to generators in which no foundation bolts have been used. There has been no need. The machines could not fly. The customers have occasionally kicked and our competitors squealed; but the plants run all right, and the engineers cannot draw them out of shape by screwing down the foundation nuts.

Syracuse, N. Y. John E. Sweet.

Removing Stop Pins

Referring to the article on page 177 about removing broken stop pins by hydraulics, I have used the same method many times in removing broken feet from drill jigs, etc., sometimes using oil and sometimes using Albany grease or similar compounds. In one extreme case I removed a broken *twist drill*, but instead of using oil or grease I used some belt dressing such as is put up in bars or sticks. In making drill jigs with hardened pins driven in for feet I always have the workman drill a small hole from the side into the bottom of the hole in which the foot is driven, then when a foot is broken off the hole is already there and in the correct location for the hydraulic trick.

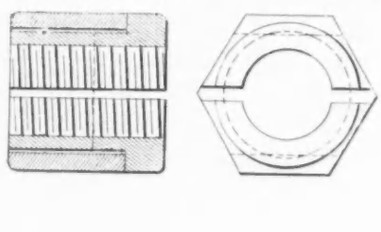
Philadelphia, Penn. J. E. P.

Split Nut for Assembling Automobiles

I am employed by the Colburn Auto Company and was given the job to scrape in the crank-shaft bearings. The studs which hold the caps were ½x20 and projected above the cap 1⅜ inches, to allow for jam nut. The nuts to be used were very close fitting, which made it necessary to use a wrench; as caps must be removed so often when scraping, I found it a very slow job.

I then made one of the quick detachable nuts shown and found that it worked very successfully. The nut is split in half and in using is placed down upon the cap with the two parts in contact with the threads on the stud. Then the sleeve is slipped over it so as to engage the clutch, and it requires only from one-half to one turn of the nut to put the cap down solid.

The foreman was very much pleased



SPLIT NUT FOR ASSEMBLING AUTOMOBILES

with the scheme and had me make three more. I think I saved the cost of the nuts on that one job.

Denver, Colo. FRANK H. MCGEE.

A Lubricant for Aluminum

I have used vinegar as a lubricant when cutting aluminum and find it leaves the surface as smooth as though it had been polished.

St. Louis, Mo. C. G. H.

Fitting Guide Pins

It happens often, notwithstanding the care given to the drilling of the guide hole in punching tools, that the pins do not work well, which means a wear of the bolster plates and then changing for bigger guides. The following system, though more expensive at the start, repays well when the work has been done carefully in the cutting parts.

In the upper bolster plate *A*, the hole is reamed taper, and the guide pin *B* is fitted into it nicely, so that the shoulder comes in contact with the face of the plate. In the bottom plate *C*, the hole is drilled with a coarse feed, giving it a rough surface. On the hardened and ground pin *D* is fitted a cast-iron bushing *E*, which also is rough turned on the outside so the babbitt will cling to it.

When everything is in place with the punch and die assembled together, the

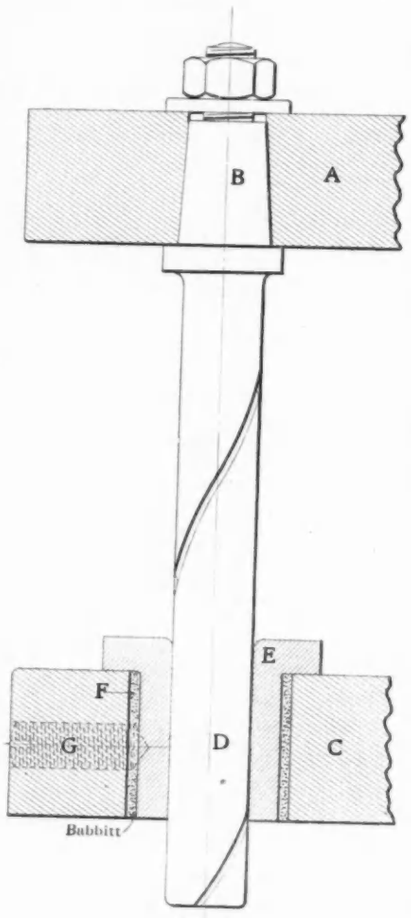


FIG. 1

A METHOD OF FITTING GUIDE PINS

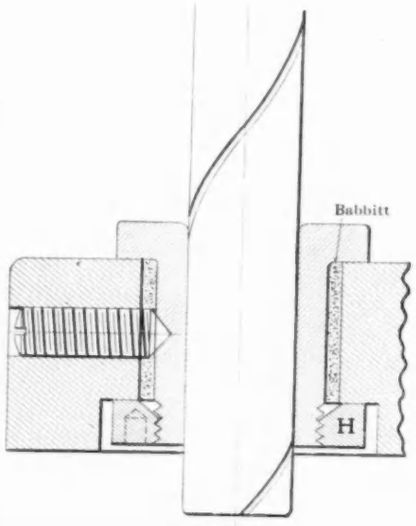


FIG. 2

METHOD USED FOR LARGER TOOLS

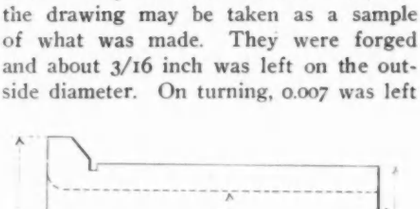
bushing is pushed against the plate and babbitt is poured in, filling the space *F* on Fig. 1. Before taking apart, a headless screw *G* is screwed into the bushing to prevent any movement. Helical oil grooves are cut on the pin to lessen the wear due to friction. For larger tools, the nut in the upper plate is counterbored and the bushing, after babbitting, is tightened with a nut bearing only on the casting, as shown at *H* in Fig. 2.

Erie, Penn. P. F.

Expansion in Hardening

On page 558 Herman Fletcher states that, in his experience, carbon steel will not increase in size or expand in any way in hardening. Now I would like to draw his attention to a case that came under my notice.

Some time ago we had large templets to make, for cylinders and covers; they required bushes of 1⅛ per cent. carbon steel. They were of various sizes, but the drawing may be taken as a sample of what was made. They were forged and about 3/16 inch was left on the outside diameter. On turning, 0.007 was left



BUSHING THAT EXPANDED IN HARDENING

in the hole and a little more on the outside diameter for grinding. They were hardened in water, and it was found that in every case they were larger on both the out and inside diameters, some as much as 0.010; and they were worse at the ends.

For the next lot we tried annealing them, after rough turning and boring, 1/16 inch being left all over for turning to a grinding size after annealing. On hardening this lot, very little alteration occurred. I suppose the compression set up in forging caused them to expand on being heated, and they failed to contract an equal amount on being cooled in the water. The annealing of the second lot removed this compression.

Perhaps Mr. Fletcher means that carbon steel does not swell in bulk, which would make the hole smaller, and the outside larger. Well, he may be right; but at the same time, this was a case of expansion on the outside size, or, to suit Mr. Fletcher's argument, a case of contraction outward, which is certainly a new way of saying expansion.

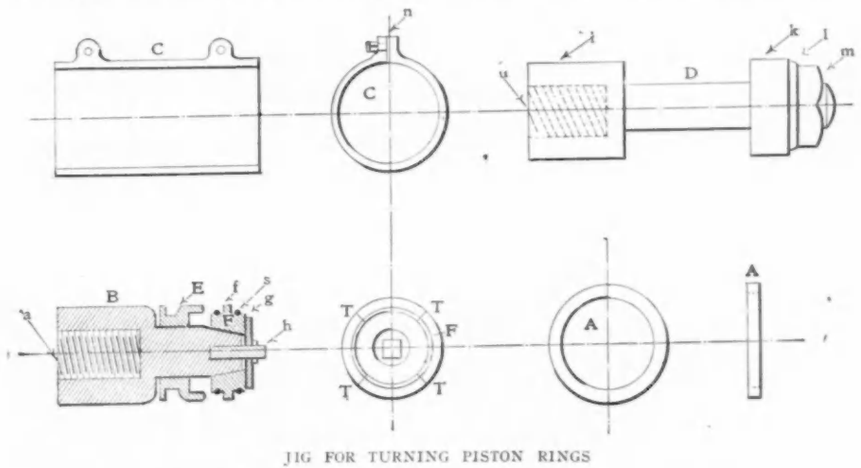
Greenock, Scotland. J. BOMBY.

Jig for Turning Piston Rings

In the sketch, *A* is a piston ring bored and rough turned just as it is when cut off from the casting. *B* is a machine-steel mandrel, case-hardened, which is threaded to fit the lathe spindle at *A*. *F* is a hardened-tool steel ring which is bored to fit the taper on the mandrel *B*, and turned on the outside at *f* to fit the inside of the piston ring *A*, with enough eccentricity to give the piston ring the required offset after it is turned. This ring is sawed at *T* into four equal parts, with two grooves turned into it at *s*, in which two split rings of steel wire fit, to hold the four parts together when taking off a turned ring or when the jig is not in use. It also has a mark on the side of it where the thin part of the piston ring comes; by bringing this mark on line with the turning tool and by running the carriage of the lathe back, you leave a mark with the turning tool where the piston ring should be split, thereby saving the time of measuring for the thin place and avoiding the inconvenience of having the boy split the rings in the wrong place.

E is a machine-steel ring bored for a running fit on the straight part of mandrel *B*, and counterbored large enough to fit over the rings *S*. This ring is used to straighten the piston rings put on at *f*. also to slide the ring *f* down the taper on *B* when the piston ring is turned and the screw *h* is unscrewed. This ring is turned on the outside simply to lighten it and make it easier to handle.

G is a machine-steel collar which is used to expand the ring *f* by forcing it



JIG FOR TURNING PISTON RINGS

up the taper on *B* when the screw *h* is screwed up.

There are several reasons why the mandrel is superior to the machine-steel mandrel shown in a previous issue, one of which is that where with the other you are limited to the amount of expansion, with this you can get at least ¼ inch expansion, which is many times the variation allowed on the bore of piston rings. Another is the quickness with which piston rings can be turned out, as it takes no time to get the rings on straight, as you simply slide the ring *e* against them with the left hand while the screw *h* can be tightened by the right. There is one more reason, and that is, if you have several sizes of rings to turn, you simply need make a new ring *f* without going to the expense of making a whole new mandrel. I have had a man straddle and turn 350 rings per day with this mandrel and a fixture I have for turning them in an ordinary engine lathe.

We now have a piston ring turned eccentric and straddled, and after being split, ready for grinding or finish turned.

C is a cast-iron cylinder split, with a ⅛-inch saw, through the lugs *n* from one end to the other, with a 1/16-inch liner in the slot which the screws in the lugs *n* clamp to. This makes a cylinder with a 1/16-inch slot when screws are tightened. and in this position it is ground on the inside so the ends of the piston rings just come together.

D is a machine-steel mandrel threaded to fit the lathe or grinder spindle at *u*, it also being ground to fit *C* at *i*, when *C* is loaded with piston rings and the screws at *n* are tightened down on the liner. *K* is a machine-steel collar which is bored for a ringing fit on *D* and turned to fit in *C* the same as *D* at *i*.

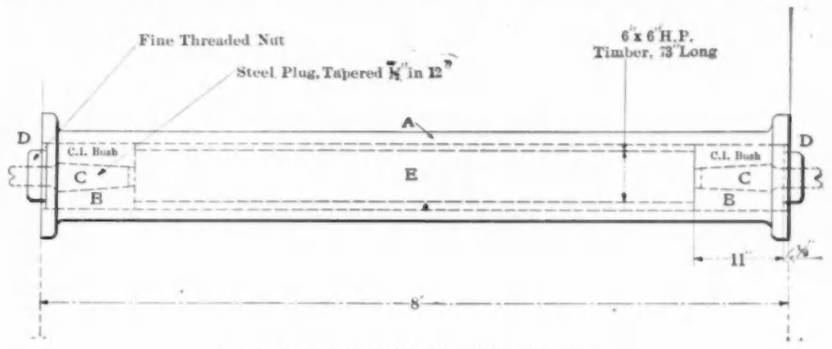
The piston rings, twelve in number, are placed in *C* with the ends just together, so the joints are opposite to the slot in the cylinder *C*. This is then slipped on *D* at *i*, *k* being slipped into the other end of *C*, which is longer than the ring. The collar *l* is put on, the nut *m* tightened until the rings are clamped between *i* and *k*, when the screws at *n* are loosened, allowing the sleeve *C* to expand so that it can be taken off, leaving the rings ready to be turned or ground as the case may be.

A. E. HEMING.

Lansing, Mich.

Turning Hydraulic Cylinder Flanges

Some years ago, I had charge of a shop where they occasionally had some hydraulic cylinders to make. These cylinders varied from 5-inch bore and 8 feet long to 16-inch bore by 10 feet long. As there were generally three or four of these cylinders bolted together, it was necessary to face both ends, and also to cut in grooves for packing, which, in this case, was made of lead. As we only had a few to make at a time and those at long intervals, we used for an arbor any bar of steel that we could find handy, that was strong enough to do the work, and drove on a cast-iron ring on each end after the bar had been slipped into the cylinder. For instance, if the cylinders were 8-inch bore, we would probably use a 3-inch bar of steel with the 8-inch cast rings driven on each end.



TURNING HYDRAULIC CYLINDER FLANGES

This method was not very satisfactory, so when the firm finally received a large order for cylinders of different sizes, we decided to devise some better way to do the work. The result was the device shown in the inclosed sketches and consisted of the two cast-iron bushings *B*, two steel mandrels *C* and the two nuts *D*.

Fig. 1 shows the cylinder ready to put in the lathe for facing. The method of operating was as follows: The cylinder *A* having been bored to size, a piece of 6x6-inch hard pine *E* of the proper length was placed in the cylinder. The two split bushings were then slipped in each end and butted up close to the hard pine stick already mentioned. The two steel mandrels were then put in place, and the whole lifted into the lathe. The mandrels being tapered, ½ inch in 12 inches, would spread the split bushings to a tight fit in the cylinder as soon as the lathe centers were tightened up. After the lathe work

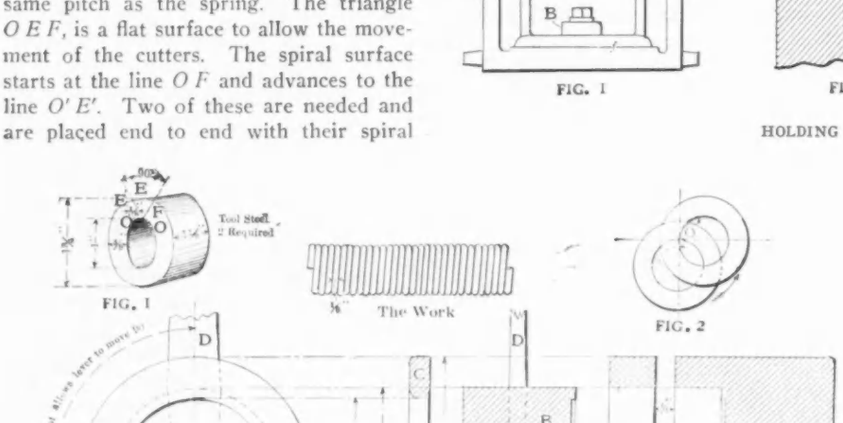
was finished, the cylinder was lifted to the floor, and by means of the threaded nuts *D* the mandrels were easily pulled out. The bushings being made a slip fit before slotting, would collapse sufficiently to be easily pulled out and would always remain true. We made over one hundred cylinders of different sizes, using these tools, and the results were very satisfactory.

Worcester, Mass. L. F. CHARLES.

Cutting Coiled Springs

One little job in a shop where I was once employed was to cut up long lengths of coil spring into 4-inch pieces. The wire used was annealed steel about ⅛ inch in diameter and was first close wound in lengths of about 7 feet with an outside diameter of 1 inch. It was then necessary to cut these into 4-inch lengths without separating the coils or bending the ends out of position, as a plug with a hook on it had to be screwed into the ends of the springs. This, I think you will admit, was a rather mean job in lots of a thousand or more. The old way was to measure off the lengths and nick the wire with a chisel, then break it in a vise. I got tired of this and devised the tool shown in the drawings.

Fig. 1 shows one of the tool-steel cutters before driving into its seat. It is a hollow cylinder bored a loose fit for the spring, with one end cut spiral of the same pitch as the spring. The triangle *O E F*, is a flat surface to allow the movement of the cutters. The spiral surface starts at the line *O F* and advances to the line *O' E'*. Two of these are needed and are placed end to end with their spiral



CUTTER FOR COIL SPRINGS

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In using this rig the coils cannot be crushed in, as they are inclosed at all points and the only place the wire can bend is at *O*, Fig. 2. A gage may be fitted to make the ends of the wire come in the same relation to each other on the circumference.

I have often wondered how jobs like this are done in other places.

F. W. FULLERTON.

Minneapolis, Minn.

Boring Holes in Jigs—Requirements in Jig Work

The exceptions taken by Mr. George, at page 915, Vol. 30, Part 2, to the use of a milling machine for locating bushing holes in jigs is noted with interest, especially as this method has been adopted by several shops of my acquaintance as being peculiarly economical and satisfactory for the purpose intended. This intended purpose is the production of jigs for work closely related to the sewing-machine class and other work of similar refinement. As the results secured are efficient, measured by an exceedingly small percentage of inaccurate production (which, by the way, has never to my knowledge been traced to inaccuracy of lay-out), it would seem that the milling machine, if judiciously selected, inspected and cared for, must be an effective adjunct in the location of jig bushings.

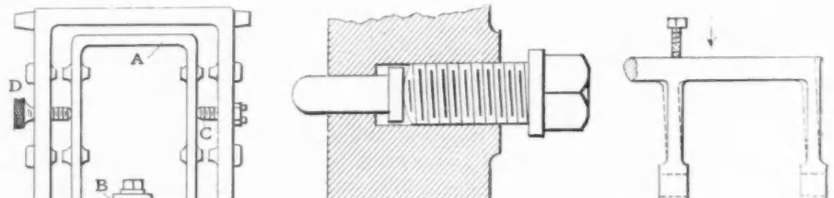
It seems to me, further, that to set an arbitrary limit of 0.0001 inch in locating jig bushings is fully as wasteful as to machine the outside of the jig within 0.001 inch. While it may be possible to lay out jigs accurately within 0.0001 inch, it is safe to say that this degree of refinement is seldom accomplished except in the imagination.

But this is not written so much to precipitate a discussion of the possibilities of accurate measuring or machining, as to draw out an expression of how far the attempt at ultra refinement may profitably be carried in jigmaking.

LIMIT DIMENSIONS ON JIG DRAWINGS

In the first place, it is believed that the use of "limit" dimensions cannot be more profitably employed than on the drawings for special tools. Jigs and fixtures are costly at the best, and this cost is frequently increased by an idolatrous feeling that anything branded as a jig is sacred and must be treated with caution, irrespective of whether its office is to locate lag-screw holes or to produce chronometer parts. We have all doubtless seen jigs bored on a lathe with infinite pains, when they might as well have been laid out with a two-foot rule and a scratch awl and bored on a drill press. And the toolmaker or even his foreman cannot always be held accountable, or even charged with the superstition of idolatry, as above. Not infrequently neither has any adequate knowledge of the part for which the jig is made. If two holes are to be 3 inches apart, it is, as Mr. George says, a question whether that means 3 inches within 1/64 inch or 3 inches within 0.0001 inch. As the article in question is a "jig," imagination may dictate extreme accuracy when a note on the drawing would forestall any misconception.

Unfortunately there are many to whom the one great attribute of a jig is accuracy of lay-out. Most jigs, even for fine work, are used with commercial or stock drills and other tools which are not accurate within so fine a limit as 0.0001 inch. Moreover, even if we assume that



HOLDING WORK IN JIGS

they are accurate, wear will take place between the bushing and the tool. Again, the machines in which the jigs are used are seldom "dead accurate." Continuous use of jigs will peen a drill table out of true. A chip under the foot of a jig will throw the latter out of level and tend to divert the drill.

Errors in Design

Besides these contributory causes, and more important, are constitutional defects in the jig itself. I have in mind a case where tools were made by a concern of repute for a small machine. The frame was rectangular, unsupported by any braces. Following a practice usual in some cases, the bottom of the frame was milled to establish a basis for operations, and the jig for the subsequent drilling operations was made to work from this milled base. Fig. 1 shows the arrangement quite well, or, at least, the features to which attention is directed.

The frame was about 10 inches high, and the walls, of about 5/16 inch thickness, had each two bearing bosses, one drilled with a 3/8-inch hole and the other with a 1/2-inch. Note how these cuts were supported. The frame *A* was placed in the jig against the gage point *C* and clamped by the clamp *B*. There were other minor holding points, but they had no immediate effect on the cuts discussed. Before the clamp *B* was tightened, the nurled-head screw *D* was turned up "just snug" against the frame. With this arrangement, the pressure of the cuts came on the frame itself. There were no abutments adjacent to the sides to support them, and as a result the pressure of the drill was sufficient to spring the sides over 1/16 inch away from the points of the screws *C* and *D*. Further, it was found that with the least exertion the screw *D* could be caused to spring the frame. When the resulting poor work was discussed, it developed that the bushing holes had been laid out with most painstaking accuracy and that no faulty work could be attributed to any insufficiency in that direction.

Clamping Devices

On some classes of work poor results are precipitated by the use of poorly made or poorly applied tightening screws. If a screw bears eccentrically on the piece held, it has an exceedingly active tendency to move the work, depending on the latter's form and mode of support and its own shape, the extent of eccentricity of its bearing and pitch of its thread. For very fine work I believe a tightening screw should never bear directly on the work, but should have an intermediate piece between its point and the work, where practicable, as in Fig. 2. If screws must be used, then they should have long cylindrical stems fitted to reamed holes, with spherical ends. The shifting effect of an eccentrically bearing screw is well illustrated in Fig. 3, where the piece operated on had two unsupported legs, at the extremities of which were hubs, to be bored with holes of substantial diameter. Suitable abutments were provided to withstand the stress of the cuts, and the holding devices were admirable in every particular save for a tightening screw situated about as indicated. Owing to irregularities in the castings, an eccentric bearing was had on the screw, which, when tightened, sprung the casting as indicated by the dotted lines.

These examples could be multiplied many times with variations. It is well to note also that the two samples cited were not the productions of amateurs or apprentices, but of men experienced in the construction and use of special tools.

Working to Close Limits

It is easy to talk of working to 0.0001 inch, but not as easy to accomplish it. In a shop of my acquaintance they once had a workman who loved to talk in this subdivided micrometric strain. One day he turned over to the inspector a product of his laborious painstaking with substantially the accompanying blessing: "Aye, lad, but there's a fine jig for ye. 'Twill not require any inspecting, for it don't vary the ten-thousandth part of an inch." But less skilled hands were obliged to rebore the jig and refine it within cruder limits.

One other matter of consideration is that of temperature. On measurements of substantial extent, expansion or contraction of the usual measuring tools will disqualify them for superlative refinement.

I do not question even the feasibility of working within 0.0001 inch on certain classes of work, but an attempt to locate the bushings or other guiding devices of special tools within so close limits savors of supererogation for the average work; and for most work that is way above the average, for the following reasons:

1. The demands of fitting and of operation are seldom as close, or anywhere near it, in the piece after it is made.

2. Such extreme accuracy is usually futile, because the jigs are used on machines that do not approximate such refinement under operative conditions.

3. The art or science of efficiently holding work is so little understood, or so frequently ignored, that extra refinement of spacing bushings is rendered fruitless by poor holding means.

No arbitrary limit should be set for accuracy. The limits of accuracy should be specified on the drawing and apportioned with regard to the piece machined.

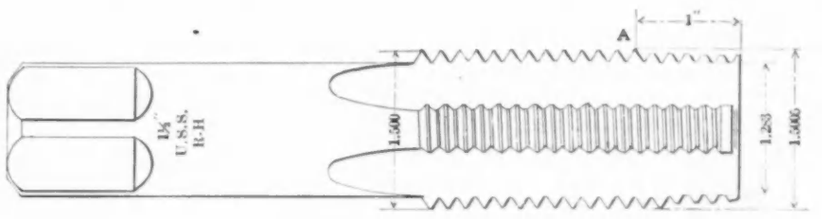
Providence, R. I. P. S. Prince.

"Distortion of Taps in Steel Hardening"

For the benefit of Mr. Hardy and other readers of the American Machinist who may be interested in the above subject, I should like to quote in part from an article, "Tool Steel and Its Changes in Hardening," which appeared in the *Journal* of the Society of Mechanical Engineers, Tokio, Japan, some ten years ago.

"The steel used for the taps was bought from a company in Paris and called 'cutter steel.' Owing to the fact that the bar from which the taps were to be made was of larger diameter than required for the work, I had it drawn down and thoroughly annealed before machining.

"As the taps were only to be used to



TAP WHICH SHRUNK LENGTHWISE AND EXPANDED IN DIAMETER WHEN HARDENED

tap about eight holes each, no test of the steel was made previous to making the taps; therefore one would expect to find an error in pitch that would be sufficient to condemn a first-class tool, but the error which was found to exist when the taps were completed was far in excess of anything expected.

"The right-hand tap (see figure), after it had been hardened and tempered, was found to have shrunk 0.0435 inch in the full length of the threaded portion, or 0.0145 inch to the inch in length.

"Not only was the length of the taps affected, but also the diameter, the diameter of the right-hand tap having expanded 0.0097 inch at point *A*, making the total diameter 1.5112 inches. The left-hand tap was found to have expanded at point *A* 0.0067 inch, making its total diameter 1.5082 inches."

I understand that the writer of the article from which I have made the above quotations made other tests, and out of forty-two, thirty-four were found to have expanded anywhere from 0.001 to 0.0057 inch. Five were found to have contracted from 0.001 to 0.002, two only remaining standard size.

A. Gwaikokujin.

Tokio, Japan.

was finished, the cylinder was lifted to the floor, and by means of the threaded nuts *D* the mandrels were easily pulled out. The bushings being made a slip fit before slotting, would collapse sufficiently to be easily pulled out and would always remain true. We made over one hundred cylinders of different sizes, using these tools, and the results were very satisfactory.

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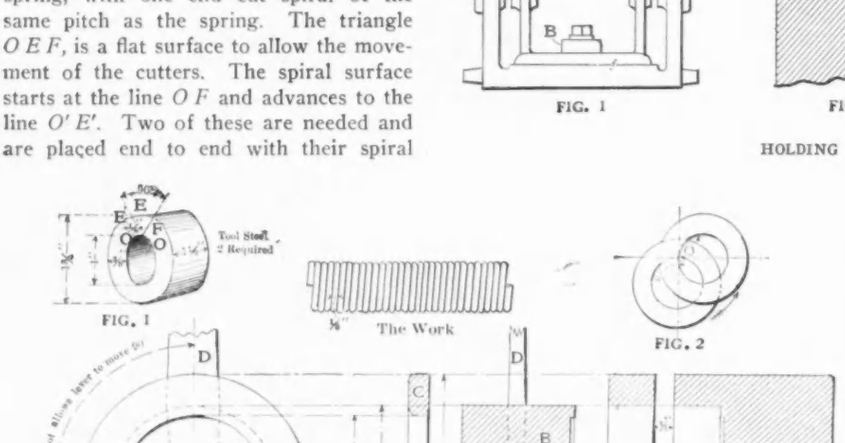

FIG. 1 FIG. 2

FIG. 3

CUTTER FOR COIL SPRINGS

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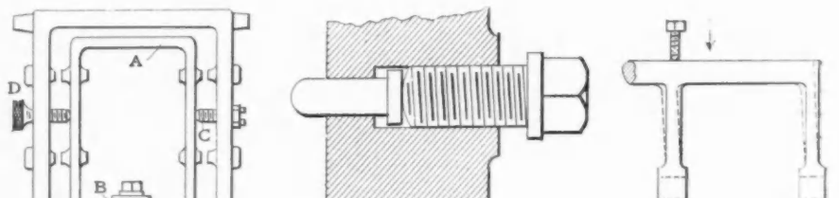

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HOLDING WORK IN JIGS

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Errors in Design

Besides these contributory causes, and more important, are constitutional defects in the jig itself. I have in mind a case where tools were made by a concern of repute for a small machine. The frame was rectangular, unsupported by any braces. Following a practice usual in some cases, the bottom of the frame was milled to establish a basis for operations, and the jig for the subsequent drilling operations was made to work from this milled base. Fig. 1 shows the arrangement quite well, or, at least, the features to which attention is directed.

The frame was about 10 inches high, and the walls, of about 5/16 inch thickness, had each two bearing bosses, one drilled with a ⅜-inch hole and the other with a ½-inch. Note how these cuts were supported. The frame *A* was placed in the jig against the gage point *C* and clamped by the clamp *B*. There were other minor holding points, but they had no immediate effect on the cuts discussed. Before the clamp *B* was tightened, the nurled-head screw *D* was turned up "just snug" against the frame. With this arrangement, the pressure of the cuts came on the frame itself. There were no abutments adjacent to the sides to support them, and as a result the pressure of the drill was sufficient to spring the sides over 1/16 inch away from the points of the screws *C* and *D*. Further, it was found that with the least exertion the screw *D* could be caused to spring the frame. When the resulting poor work was discussed, it developed that the bushing holes had been laid out with most painstaking accuracy and that no faulty work could be attributed to any insufficiency in that direction.

Clamping Devices

On some classes of work poor results are precipitated by the use of poorly made or poorly applied tightening screws. If a screw bears eccentrically on the piece held, it has an exceedingly active tendency to move the work, depending on the latter's form and mode of support and its own shape, the extent of eccentricity of its bearing and pitch of its thread. For very fine work I believe a tightening screw should never bear directly on the work, but should have an intermediate piece between its point and the work, where practicable, as in Fig. 2. If screws must be used, then they should have long cylindrical stems fitted to reamed holes, with spherical ends. The shifting effect of an eccentrically bearing screw is well illustrated in Fig. 3, where the piece operated on had two unsupported legs, at the extremities of which were hubs, to be bored with holes of substantial diameter. Suitable abutments were provided to withstand the stress of the cuts, and the holding devices were admirable in every particular save for a tightening screw situated about as indicated. Owing to irregularities in the castings, an eccentric bearing was had on the screw, which, when tightened, sprung the casting as indicated by the dotted lines.

These examples could be multiplied many times with variations. It is well to note also that the two samples cited were not the productions of amateurs or apprentices, but of men experienced in the construction and use of special tools.

Working to Close Limits

It is easy to talk of working to 0.0001 inch, but not as easy to accomplish it. In a shop of my acquaintance they once had a workman who loved to talk in this subdivided micrometric strain. One day he turned over to the inspector a product of his laborious painstaking with substantially the accompanying blessing: "Aye, lad, but there's a fine jig for ye. 'Twill not require any inspecting, for it don't vary the ten-thousandth part of an inch." But less skilled hands were obliged to rebore the jig and refine it within cruder limits.

One other matter of consideration is that of temperature. On measurements of substantial extent, expansion or contraction of the usual measuring tools will disqualify them for superlative refinement.

I do not question even the feasibility of working within 0.0001 inch on certain classes of work, but an attempt to locate the bushings or other guiding devices of special tools within so close limits savors of supererogation for the average work; and for most work that is way above the average, for the following reasons:

1. The demands of fitting and of operation are seldom as close, or anywhere near it, in the piece after it is made.

2. Such extreme accuracy is usually futile, because the jigs are used on machines that do not approximate such refinement under operative conditions.

3. The art or science of efficiently holding work is so little understood, or so frequently ignored, that extra refinement of spacing bushings is rendered fruitless by poor holding means.

No arbitrary limit should be set for accuracy. The limits of accuracy should be specified on the drawing and apportioned with regard to the piece machined.

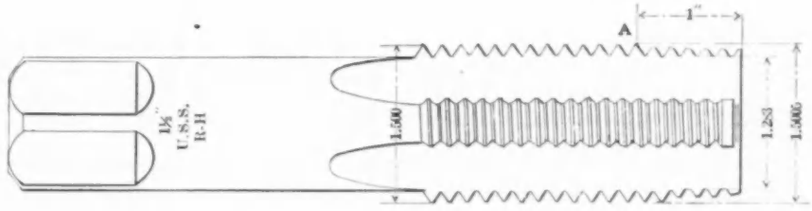
Providence, R. I. P. S. Prince.

"Distortion of Taps in Steel Hardening"

For the benefit of Mr. Hardy and other readers of the American Machinist who may be interested in the above subject, I should like to quote in part from an article, "Tool Steel and Its Changes in Hardening," which appeared in the *Journal* of the Society of Mechanical Engineers, Tokio, Japan, some ten years ago.

"The steel used for the taps was bought from a company in Paris and called 'cutter steel.' Owing to the fact that the bar from which the taps were to be made was of larger diameter than required for the work, I had it drawn down and thoroughly annealed before machining.

"As the taps were only to be used to



TAP WHICH SHRUNK LENGTHWISE AND EXPANDED IN DIAMETER WHEN HARDENED

tap about eight holes each, no test of the steel was made previous to making the taps; therefore one would expect to find an error in pitch that would be sufficient to condemn a first-class tool, but the error which was found to exist when the taps were completed was far in excess of anything expected.

"The right-hand tap (see figure), after it had been hardened and tempered, was found to have shrunk 0.0435 inch in the full length of the threaded portion, or 0.0145 inch to the inch in length.

"Not only was the length of the taps affected, but also the diameter, the diameter of the right-hand tap having expanded 0.0097 inch at point *A*, making the total diameter 1.5112 inches. The left-hand tap was found to have expanded at point *A* 0.0067 inch, making its total diameter 1.5082 inches."

I understand that the writer of the article from which I have made the above quotations made other tests, and out of forty-two, thirty-four were found to have expanded anywhere from 0.001 to 0.0057 inch. Five were found to have contracted from 0.001 to 0.002, two only remaining standard size. A. Gwaikokujin.

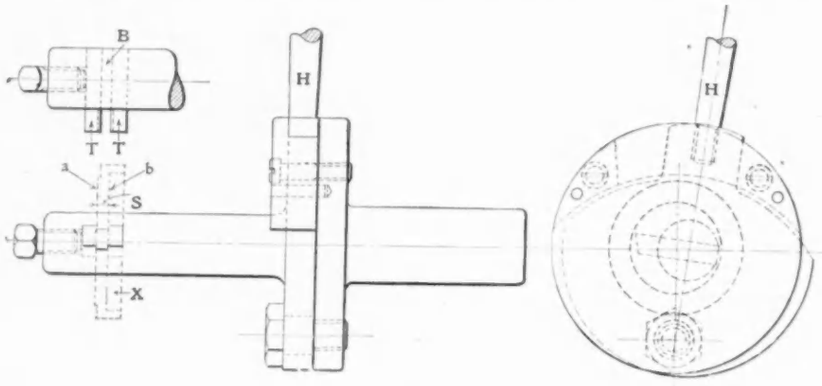
Tokio, Japan.

A Double Facing Tool

The illustrations show a small casting *X* and a special tool for machining it. The tool is used in a turret lathe and after the hole is bored, is brought to the position shown, when the handle *H* is drawn toward the operator and the tools *T* and *T* cut the sides *a* and *b*. Size *S* is maintained by having a block *B* of the desired thickness between the two tools. By using this tool, the sides *a* and *b* must come parallel and the time is reduced to a minimum.

W. R. G.

Youngstown, Ohio.



A DOUBLE FACING TOOL

A Sizing Tool for the Lathe

Sizing tools with inserted blades are pretty much alike, most of them being made with snug-fitting grooves, for blades of self-hardening steel.

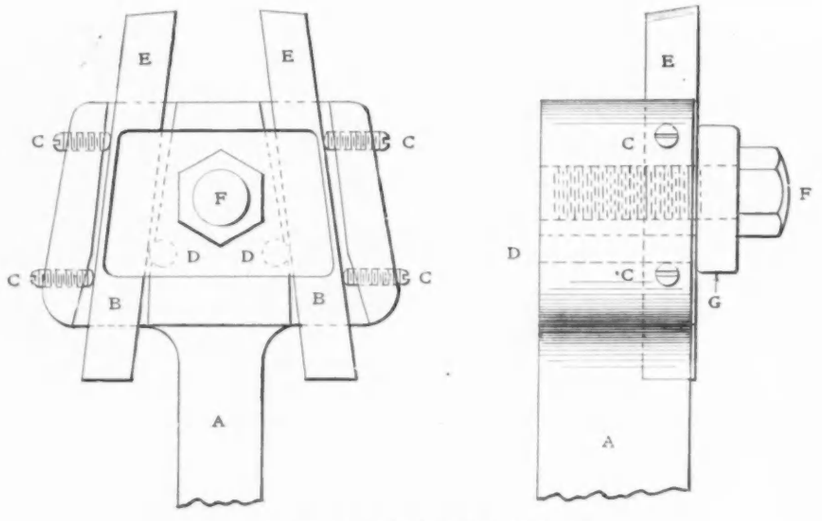
I show herewith a sizing-tool holder, with enough improvement in design to warrant my sending it.

A is the holder with a shank small enough to fit the tool holder. *B B* are two slots cut in such a manner as to give the greatest adjustment to the blades. *C C* are the adjusting screws. *D D* are two pins on which the blades rock; this movement with this size tool allows for an adjustment from less than ¼ inch to over 1 inch. *F* is a cap screw which binds the clamp *G*, thereby holding the cutters firmly once they are set.

To set the cutters is a simple matter. Place an arbor on the centers of the lathe, set the points of *E E* against the arbor, then by the aid of a set block or any piece of the right size placed between the points, the exact spacing is easily obtained.

This style of tool is very handy for manufacturing work, such as gear blanks, rolls, collars, etc., where a standard size is important.

Boston, Mass. A. PEDRO.



A SIZING TOOL FOR THE LATHE

Tool for Accurately Reaming Valve Body

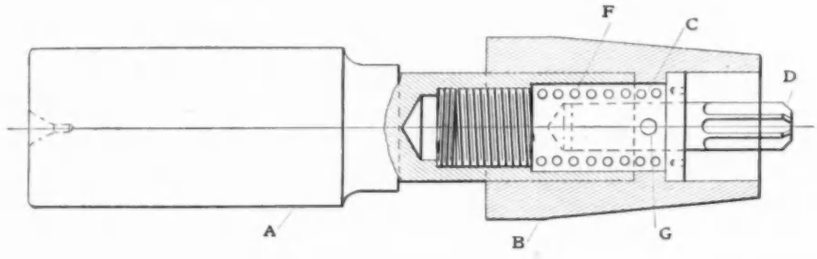
Some time ago we had a rather tough time with a hole in the bottom of a certain valve we were making, and the method we finally adopted is rather ingenious, although it may not be new to all of your readers. The hole had to be reamed to a close limit, and at the same time run true with the tapered key-seat. The drawing herewith shows the tool, and a short description will give its working.

The shank *A*, turned to fit the turret, is made of machine steel case-hardened and ground, being a nice running fit on the other end in the sleeve *B*. This sleeve is ground on the outside to fit the taper in the valve body, being made just to correspond with the test plug to which the valves are turned. The plug *C* carries the reamer *D*, screws into the shank *A* and is a nice running fit in the sleeve *B*. The reamer is held from turning by the pin *G*, and the sleeve is held against the shoulder on *C* by the spring *F*.

In use the sleeve seats itself in the taper portion of the valve body, and a further advance of the turret compresses the spring *F*, allowing the reamer to enter the hole at the bottom of the valve body and ream it exactly concentric with the tapered portion.

M. R. KAVANAGH.

Detroit, Mich.



TOOL FOR ACCURATE REAMING

Standard Tool Posts for Lathes

Referring to Mr. Oyen's article, on page 98, on standard tool posts, I wish to call attention to the fact that the tool post shown was adopted, in connection with cupped washer and convex gib, for its time-saving features in setting the tool. Now Mr. Oyen takes this post and discards its only advantage by using flat washers and introducing shims, leaving it with its former lack of rigidity and interference when working close to chuck so that offset tools had to be used, and further weakens it by cutting the slot down close to its weakest point, at the neck. Then he gives us a fancy little washer with legs on it, which is of very little value, as the legs are not directly under

the tool and are unnecessary anyway, because there is no place for the washer to spring to, even if it wanted to do so.

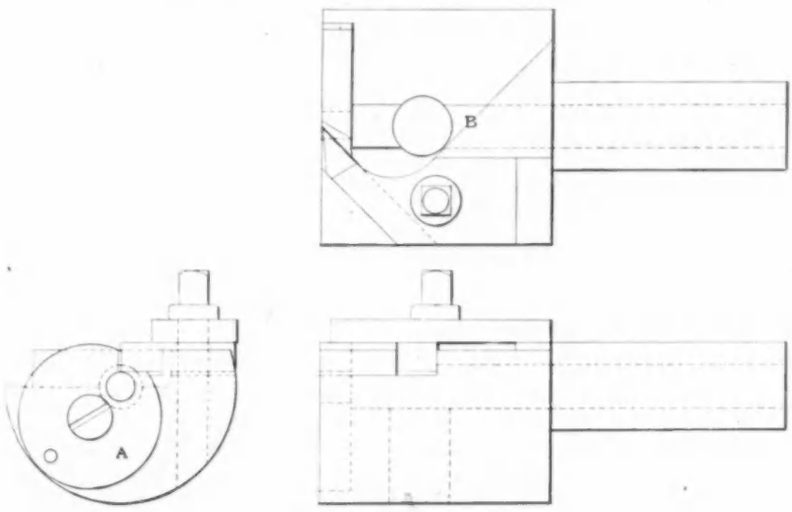
What I wish to say is that if shims must be used, why not use them where they properly belong, as in the British type with the two straps and four studs, any one of these studs being at least as strong as the set-screw in the ordinary tool post.

The rest is not weakened by a T-slot, the lips of which, sooner or later, get broken off; straight tools can be used close to the chuck, and there is no set-screw to get broken or burred up at the point.

Ottawa, Canada. O. T. WATT.

A Tool for the Turret Lathe

The tool shown was made in a hurry to size at one cut one of a number of shoulders on a piece which required more tools than there was room for in the turret, had a roughing and finishing tool been used for each size. For the most important shoulder a finishing tool was used, but the finish and accuracy were not much if any better than that of the single tool of this kind.



A TURRET LATHE TOOL

It consists of a body turned to fit the turret and having on the front end a recess *A*. Into this recess was fitted a tool-steel disk doweled and held by a fillister-head screw. The shank was then held in a draw chuck, the hole in the bushing bored to size and the outside corner slightly rounded.

The bushing was then removed and the body milled out for the inserted cutter and for chip clearance. The portion above the line *B* is about even with the center line, and the portion below *B* about even with the top of the cutter. A portion was cut out of the bushing to make room for the cutter and for chip clearance; then it was hardened, replaced and lapped to size. The cutter was a piece of self-hardening steel ground as indicated, with the liner of cutting corner rounded very slightly.

Bushings of various sizes were afterward made for this tool with suitable blocks to raise the cutter the distance necessary to keep the cutting edge tangential, a condition which is necessary for satisfactory work. The groove should be made deep enough to reach the smallest diameter of work that is desired. If the dimension from the center line to the bottom of the groove is accurately known, it will facilitate the setting of the tool for any other size.

Marquette, Mich. E. C. O.

Checking Drawings

I agree with Mr. Allen when he asserts on page 59 that it is not the checker's business to criticize design; his work should be confined to seeing that the drawing is properly and correctly figured, that the proper allowances are made for finish, and that all features which are conveyed on the layout from which it has been made, and such incidental features as are not shown on the layout, but which should be on the detail drawing, are embodied. Mr. Allen also states that good results are obtained by subjecting the drawing, before it is traced, to the criticism of a committee composed of all those who are in any way interested in the tools to be made from the drawings. He suggests that if the design is changed, "make new drawings if necessary." It would appear that it is rather a late time to discover that a change in design is necessary after detail drawings have been made.

There is a system which is practiced by one of the largest and most successful manufacturing concerns in the country, which provides that all designs are thoroughly criticized and made acceptable before a detail drawing is made. One or more draftsmen, under the constant supervision of a competent machine designer, make the necessary layouts for the required mechanism. Because the designer is in constant touch with the work of the draftsman, the layouts, when completed, can be subjected to the severest kind of criticism and be found wanting in few respects. These layouts should be complete enough to show as many views of each part as it will be necessary to show on a detail drawing, thereby making it possible to obtain as clear an idea of that particular piece of mechanism as would be gained from a study of the details. This does not mean that the layouts shall be unusually elaborate, that much ought to be done in any case, as the detail draftsman, who can hardly be expected to be a mind reader, cannot work to advantage if he has before him on the layout practically all that he is expected to embody in the drawing. It follows that more than one view of each detail should be shown on the layout. There are those who will state that many incidentals can be left off the layouts if the details are properly supervised by the draftsman responsible for the layouts. Are there incidentals any more far-reaching in their bearing on the general design than methods for oiling, recesses for machining into, etc.? If these are lacking the layout man has not properly finished his layout.

When the layouts are finished to the state which I have mentioned, they should be carefully explained to a committee composed of all persons who are to be interested in the production of the various parts of the mechanism involved. If changes in design result from such a procedure, they are, as a rule, small, and the layouts being only slightly affected are easily changed. After the layouts have been made to embody changes which have been decided upon they can be handed over to detailers who can then work to good advantage. The laying-out draftsman should follow the detailer's work to see that provisions for lubrication, stock for fitting, and such incidentals as he has not conveyed in his layouts are embodied in the detail drawings. The completed detail should, of course, be checked. It is the custom in the drawing room of the concern where this system exists to allow the man who has made the layouts from which the detail drawings have been made to check these detail drawings. There is no doubt but that he is the best qualified person for the discharge of that duty.

New Castle, Ind. T. H. HANLEY.

According to the report of the U. S. Geological Survey the portland cement production in the United States for 1907 was considerably below the total expected. Returns of 95 per cent. of portland cement production show that about 48,000,000 barrels were produced in 1907, which is comparatively a very small increase over 1906.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1907 *we printed and circulated* 1,151,500 *copies of the* AMERICAN MACHINIST.

Our circulation for February, 1908, *was (weekly, monthly and European),* 93,750.

Mar. 5..... 36,750

This paper reaches 36,750 *separate readers each month and* 20,250 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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German Trade Schools

In view of all that has been said and written about the German system of industrial education, it is surprising that we have so little tangible knowledge of it. We know that these schools exist, that they are a large factor in German industrial development and that is about all, for of their methods we know almost nothing. This is because among the numerous reports that have been made upon them there is not, we believe, one which has been made by a manufacturer or by one who could look at the schools from a manufacturer's viewpoint. The most complete account of these schools that we have seen was made a couple of years ago by Consul-General Mason, then of Berlin. Mr. Mason's reports were admirable and our appreciation of them was attested by the liberal extracts which we reprinted. At the same time, the chief facts to be gleaned from these reports related to the extent of the schools as the system and the scope of the work undertaken in them. Mr. Mason did not, and could scarcely have been expected to undertake a critical examination of their methods.

In the suddenly awakened interest of the American public in industrial education, it behooves us as a starting point to supply the deficiencies in our knowledge of the German schools. As matters stand, there is almost nothing about them that we can copy or adopt because we have no knowledge of the things that must be copied or adopted if either is to be done. In a recent editorial we pointed out the difficulty which confronts State-supported trade schools in this country, if they are to undertake the production of a merchantable product, and the question at once suggests itself, how do the German schools surmount this difficulty? For one thing, the fact was brought out at the Chicago convention of the Association for Promotion of Industrial Education that the schools are not fully and in many cases not chiefly, supported by the Government, but by the manufacturers themselves. This, of course, puts another aspect on this difficulty, but nevertheless if the schools do commercial work they must still have a product to dispose of which in view of the numbers and size of the schools, must be considerable. Back of this question, of course, is the fundamental one, do the schools do commercial work at all, or are they essentially manual training schools? Again, if they are of this latter class, how do they accomplish the results with which they are credited?

The above will indicate how little we really know about these schools beyond the bare fact of their existence. Of course, we Americans are very prone to disdain the experience of others and to set out on a thorny path with full assurance of our capacity to get through it, but we are persuaded that this national trait often leads to a tremendous waste of energy which might easily be avoided. It seems to us that these German schools should be thoroughly examined by competent men possessing manufacturers' eyes and that this should be done through the auspices of the Association for the Promotion of Industrial Education. Now that the preliminary work has been done and the association been fully launched on what appears to be a career of assured usefulness, we believe it could do nothing more useful as the next step than to undertake the line of work which we have indicated. It was announced at the Chicago meeting that in the near future the association will employ a salaried commissioner who will devote his entire time to the work and it would seem to us that this piece of work should be undertaken by this commissioner. It is plainly folly for us to set out to solve anew problems which have already been solved by others.

The Industrial Efficiency of the Individual

It is claimed by some of the closest students of the industrial question that there has been a decrease in the industrial efficiency of the American workman during the last ten or twenty years, that he does not produce as much or as good work per day or per unit of cost as formerly, and that unless this is remedied, we are doomed to relinquish our industrial supremacy, in spite of our natural resources which place us at such an advantage over the rest of the world. Our own manufacturers, too, are complaining in a similar way, that they cannot get enough workmen who take an interest in the output and who are skilled enough to do their best work.

The social economist points to the German trade schools as the salvation of that country, and as making possible the commercial expansion which has been accomplished, and urges a similar plan in the United States that the boys may be trained into good workmen before they enter the trades at all. Perhaps the oldest school of its kind is the New York Trade School, which has been established about 27 years, and the newest the one in Columbus, Ga., which was opened last year—but their members are limited.

The late Professor Thurston is quoted as saying that we needed 20,000 trade schools with a capacity of 700,000 pupils before we would equal Germany in the proper training of artisans, and Professor Sweet is working out a plan of his own in the Artisans' School of Syracuse.

Some manufacturers would like to take men or boys ready trained and be saved all the apprenticeship problems. Others believe it pays in dollars and cents to

train them yourself, and particularly those whose work is out of the ordinary, where special training is necessary and where even good workmen have to be taught the peculiarities of their work.

Then, too, there is the work that can be done with only a short period of training, low-grade work that may require intelligence, but yet that can be acquired in a very short time; work such as a bright laborer, either foreign or native born, can readily handle. The trade school is not needed for such as these, and yet this work often forms a very important part of the product of a factory.

Again, we have the men who are expert in one branch of the trade, the milling machine, lathe, or planer, and who can naturally be trained in one branch much more quickly than in all of them. The training of this class of workmen has been very satisfactorily accomplished by Mr. Bullard with his special apprenticeship system.

Still others do not even believe in this training, but want to take a bright boy into the shop, start him on the drill press, or lathe, and make an expert of him in that line, not by training in any particular way, but by letting him pick up what he can from the foreman and others. Of course there is some supervision, but it is the direct opposite of trade-school training.

Whichever method is adopted, none will deny the extreme importance of efficiency in any line. Nor does this always mean the man who can turn out the most work in a day, but the man who can see chances for improvement and who has interest enough in his work to make or suggest it.

If the training is to be done in trade schools rather than in the shop, the kind of training must receive careful attention if we are to avoid the "unlearning process," which is so difficult and which has been necessary in too many cases with the higher technical education. The trade-school methods must be kept thoroughly practical, must approach as near to actual shop work as possible, even to its commercial limitations, and there is no good reason why the products should not be marketed at a fair price.

And, above all, the efficiency of the individual workman must be the aim if we are to expect efficiency in the whole manufacturing industry. He must be taught to do good work, to do it quickly and to realize how much the success or failure of an enterprise depends on his work and his coöperation. The spirit of loyalty and enthusiasm is an important factor in the conduct of any plant, but too many expect men to be loyal to a company name, instead of providing something more substantial and that deserves loyalty. The men who work for John Smith, machinist, may have every reason to be loyal to him from the fact that his treatment has been just, that he turns out good work at a fair price and doesn't try to "do" a customer at every opportunity, while the employees of the Great North American Manufacturing Company may have equally good reasons for disloyalty. A high-sounding name does not always mean the most exalted business methods or the fairest treatment of men or customers.

Just as there is no one great fault that is responsible for all our ills, neither is there any one remedy which will cure them all, but when people begin waking up to the fact that something must be done, there is more hope of a correct solution.

March Meeting of the A. S. M. E.

The March meeting of the American Society of Mechanical Engineers will be held on Tuesday evening, March 10, at 8.15 o'clock, in the Engineering Societies building. The meeting will be addressed by Dr. Charles P. Steinmetz, member, A. S. M. E., past president, A. I. E. E., and professor of electrical engineering, Union University, the subject being "The Steam Path of the Steam Turbine."

New Publications

A Study of Roof Trusses. Bulletin No. 16 of the Engineering Experiment Station of the University of Illinois. By N. Clifford Ricker. For gratuitous distribution.

This bulletin presents briefly the results of several years' study of trussed roofs. About 50 trusses were designed in long-leaf pine and steel and a study made to develop a formula for weight; most economical ratio of depth to span; distance between trusses; number of purlines per panel; and dimensions of panels. The conclusions are given mainly in graphic tables.

The Weathering of Coal. Bulletin No. 17 of the Engineering Experiment Station of the University of Illinois. By S. W. Parr and N. D. Hamilton.

Losses in fuel value which accompany the storage of coal under various conditions and the action of weathering on coal are set forth in this bulletin. A study was made of samples kept in the open air, under cover at various temperatures, in air tight containers and submerged in water. The results of the experiments are given.

Comparative Tests of Carbon, Metallized Carbon and Tantalum Filament Lamps. Bulletin No. 19 of the Engineering Experiment Station of the University of Illinois. By T. H. Amsine.

This bulletin gives the results of a comparative study of the electrical characteristics, life, candle-power maintenance, horizontal and vertical distribution and cost of operation of the three most widely used electric lamps under both good and poor conditions of operation. From a consideration of some of the curves given the conclusion is reached that the increase in efficiency of the metallized over the carbon filament is due almost equally to higher filament temperatures and to relative radiation, while for the tantalum filament it is due almost wholly to higher temperatures.

Report upon Smoke Abatement. By a committee consisting of John A. Mathews, Chairman; John H. Barr, W. H. Blauvelt, Carlton A. Chase, William Kent, J. D. Pennoch and John E. Sweet. 42 6x9-inch pages. The Syracuse Chamber of Commerce, Syracuse, N. Y.

Of all the publications with which we have come in contact connected with the agitation for the suppression of smoke, this report impresses us as the one most likely to produce good results. While primarily intended for the conditions at Syracuse, nearly all of it is equally applicable elsewhere. It is thoroughly moderate and temperate in tone, recognizes the necessity for coöperation with smoke makers and aims at feasible rather than ideal results. Among other things it contains a summary of replies received from letters sent to about 100 manufacturers, hotels, merchants and business firms of every description in various cities where the smoke-abatement agitation has become active, with this suggestive statement by the committee: "When we consider the results in other cities our report must assume a tone of hopeful optimism." The report discusses in thoroughly practical language the principles of combustion, the causes of smoke and the remedy. The use of steam jets, the down-draft furnace, mechanical stokers, both of the inclined grate and the underfeed type, together with their limitations, and the condition under which they are useful are carefully presented, together with the economical results to be expected from smoke abatement. The report deserves a wide circulation, which we have no doubt it will receive.

As an indication of the progress of the acetylene industry, a recent modification of the insurance rules concerning this product is of some interest. Hitherto rules formulated by the National Board of Fire Underwriters prohibited the installation of an acetylene generator in an insured building. At a recent meeting, however, the Board of Underwriters, after considering various reports on the condition of the acetylene industry, decided to strike out from its rules such words as prohibited inside installation of acetylene generators, and substituted the following: "Generators, especially in closely built-up districts, should preferably be placed outside of insured buildings in generator houses constructed and located in compliance with Rule 9."

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A 42-inch Gear-head Engine Lathe

The illustration shows a 42-inch gear-head engine lathe built by the Bridgeford Machine Tool Works, Rochester, N. Y.; one of a line recently brought out by this firm. The result aimed at in designing this machine was to produce an engine lathe with sufficient power and rigidity to fully meet the demands of modern machine-shop practice using high-speed steel, and at the same time to provide means for quickly varying the speed.

Power is applied to a constant-speed pulley 30 inches in diameter, carrying an 8-inch belt and shown at the back of the headstock. The proportions of the gearing are such that there are from 2.26 to 111 revolutions of the driving pulley to one revolution of the face plate. This gives under maximum conditions a pulling power of 25,000 pounds on a diameter of 42 inches. There are 15 speeds in geometric progression obtained through a speed variator in the headstock. All of its gears are of steel, cut from the solid and running in oil. All of the bearings are so constructed as to receive a constant supply of oil, thus insuring a high lubricating efficiency and tending to a minimum amount of wear.

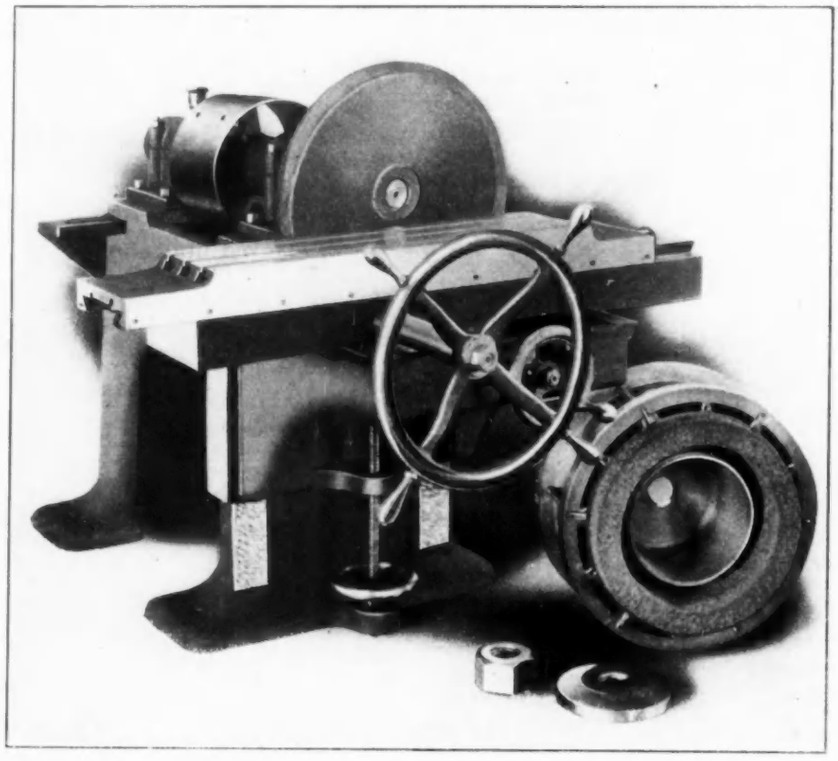
The total weight of the machine as shown is 36,000 pounds; the bed is 26 feet long. This type is built in 26, 32, 36, 42 and 48-inch swings. The length of bed is made anything desired, and it can be furnished with several attachments, including a power-operated, rapid traverse for the carriage.

When a motor-driven tool is required the motor is mounted on the headstock, the driving pulley is replaced by a sprocket or gear, and the drive is by means of a silent chain, or a rawhide pinion. Motors of a capacity from 25 to 40 horse-power are used according to the requirements of the work. Such motors may be either constant speed or with a variation of 1½ to 1 or 2 to 1. With the latter type the controller is operated from the carriage through a splined shaft.

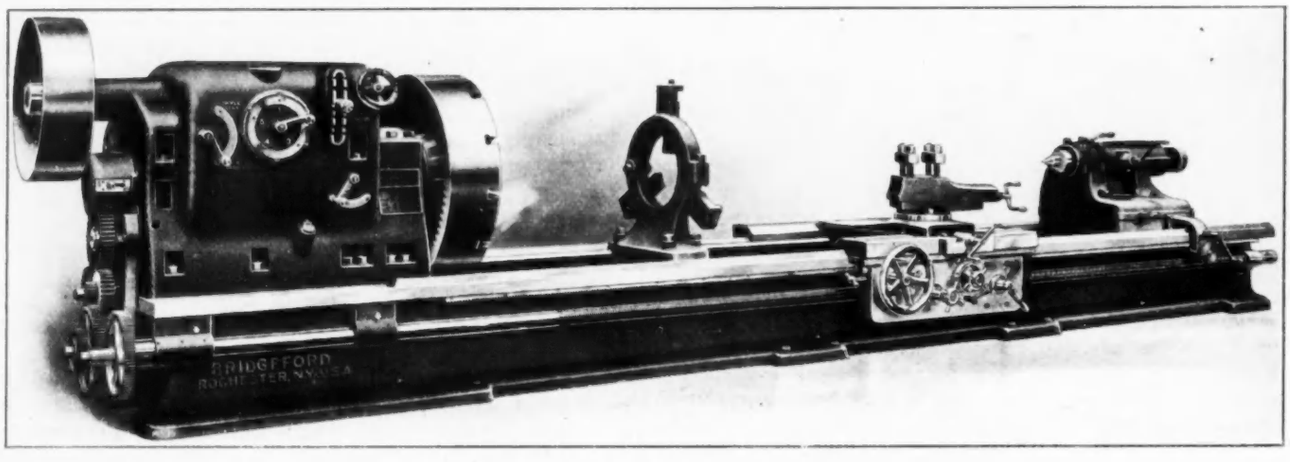
A Grinding and Disk Polishing Machine

The illustration shows a combined grinding and polishing machine.

The wheel for grinding is ring shaped, held in a ring wheel chuck, which permits of high speed, using a soft wheel. With



A GRINDING AND DISK POLISHING MACHINE



A 42-INCH GEAR-HEAD ENGINE LATHE

a suitable wheel as much as ⅛ inch of stock can be removed at one cut.

The work table is provided with T-slots for clamping work and has a vertical, transverse and cross movement. Transverse motion is actuated by means of the large hand wheel in front, which gives ample power for heavy cuts.

The disk plate and ring wheel are readily interchangeable on the spindle, and a clamp stand is furnished for clamping emery cloth to disk plate.

All castings of moderate size can be finished from the rough. This machine is built by the Safety Emery Wheel Company, Springfield, Ohio.

A Cutting-off Machine with an Inserted-toothed Blade

The illustrations Figs. 1 and 2 show front and rear views of a cutting-off machine of novel design. The teeth of the saw instead of being set in the periphery of the blade face toward the center, a large hole being provided in the center of the blade through which the stock is passed. This arrangement permits the drive of the saw to be from the periphery at or near which part the blade is secured to a ring having teeth cut on its outside to engage with a pinion of the driving mechanism. The saw blade being supported in the manner shown in the line cut Fig. 3 around the entire periphery cannot

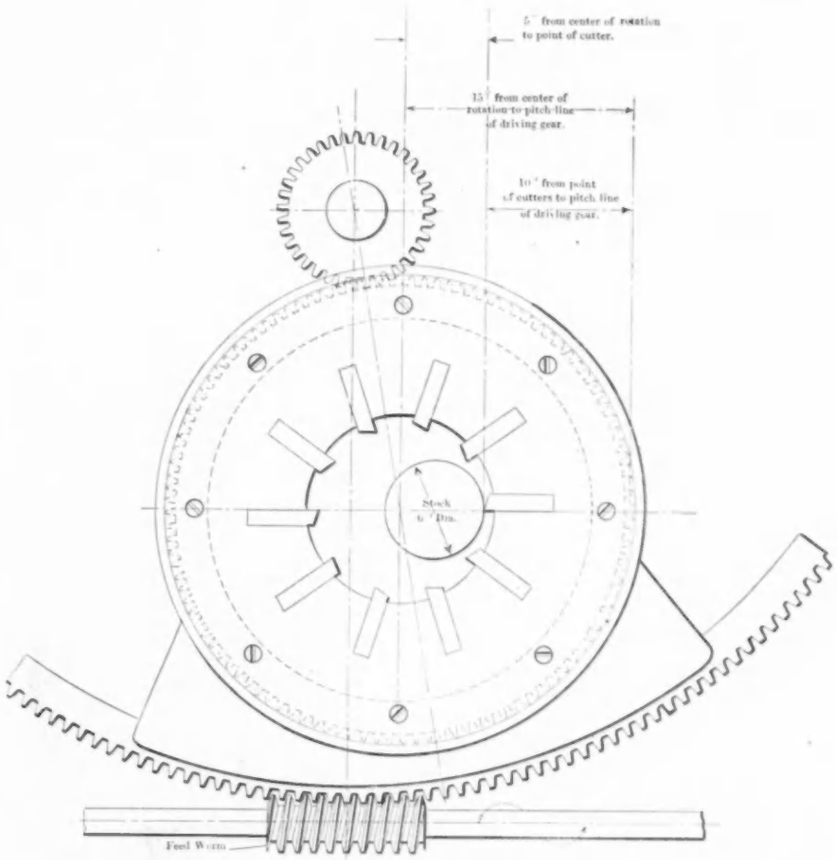
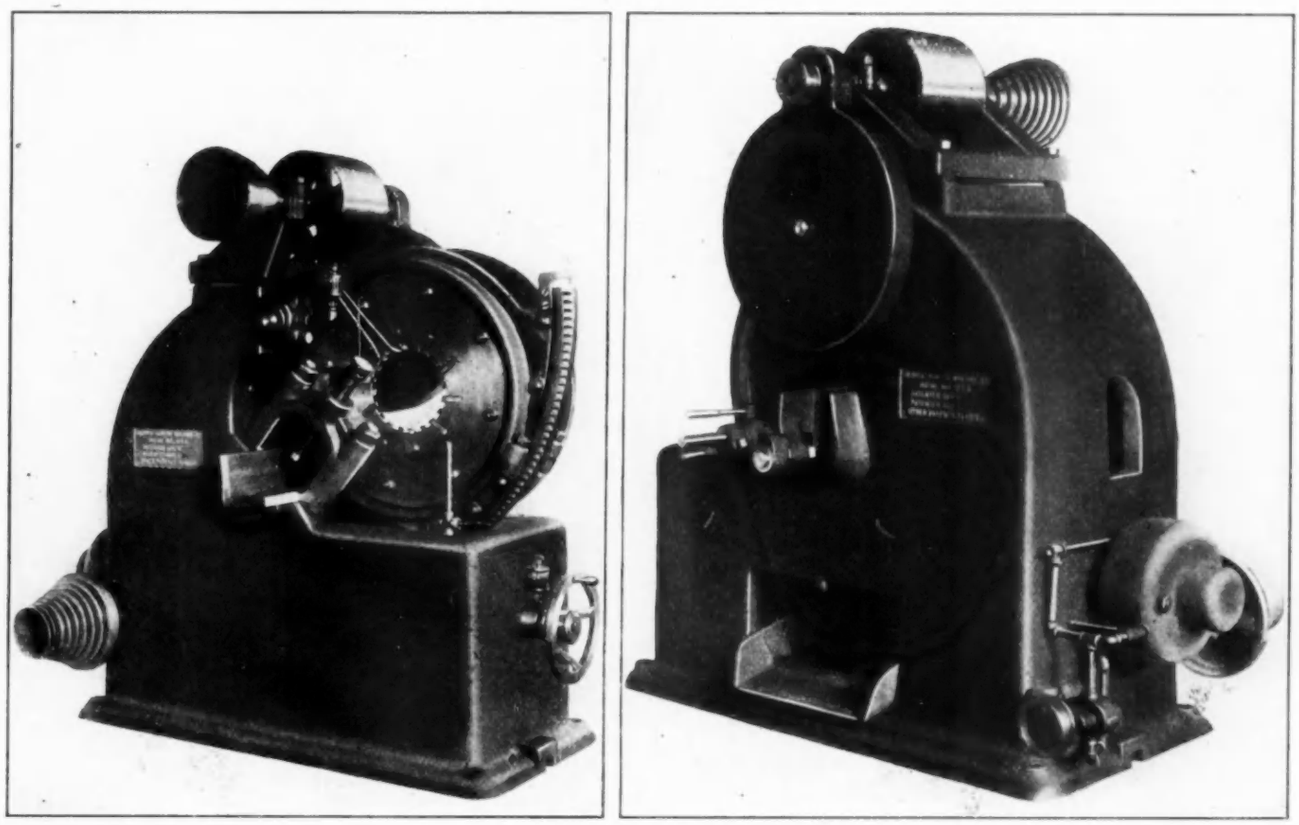

5" from center of rotation to point of cutter.
15" from center of rotation to pitch line of driving gear.
10" from point of cutters to pitch line of driving gear.
Stock 6" Dia.
Feed Worm

FIG. 3. FEEDING AND DRIVING MECHANISM



FIGS. 1 AND 2. FRONT AND REAR VIEWS OF CUTTING-OF MACHINE

buckle or snake. The inserted teeth being on the inside of the blade have little or no tendency to work out. The drive as shown is very powerful. The feed mechanism consists of a worm segment operated by a worm running in oil. The worm is mounted on a hollow shaft upon the one end of which is a large hand wheel, shown in Fig. 1 to the right. The other end of the shaft has a small worm gear connected to the shaft by a friction clutch operated by means of a push rod, the handle of which is in the center of the hand wheel.

The clamping arrangements and gage may be seen in Figs. 1 and 2. An opening at the back, shown in Fig. 2 permits the chips to be taken away from the top of the strainer where they fall. An oil pump is provided, with the necessary piping to lubricate the saw.

Six gradations of feed in geometrical progression are provided. On the machine illustrated, a 6-inch bar can be sawed in from one and a half to five and a half minutes according to the feed used. The saw teeth revolve at the rate of 75 feet per minute.

The main driving pulley is 14 inches diameter by 10 inches face, and makes 350 revolutions per minute. The power required for maximum output is 18 horsepower. Length of machine over all 84 inches; width 56 inches; hight 78 inches. Other sizes of machines are in course of construction. Well designed stock supports are an important feature. These machines are built by the George Gorton Machine Company, Racine, Wis.

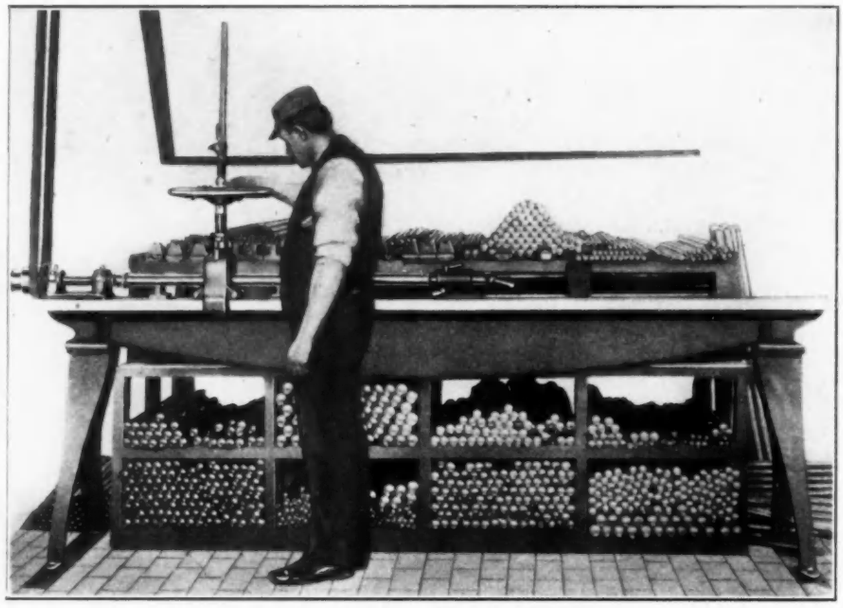
Cross-feed Attachment Shaper

Toolmakers and others who use shapers on die or similar work requiring both the vertical and cross feeds to be used at once as in following given outlines, will appreciate the new attachment of Gould & Eberhardt, Newark, N. J. This allows the cross feed to be operated from the front of the knee so that the operator can keep his eye on the line and both hands on the feed-screws without becoming a contortionist, or being afflicted with curvature of the spine.

The two photographs show the difference in the position and the comfort of the machinist with both locations of the cross-feed handles, and make one of the object lessons that speak louder than words. This is being built as an attachment to their line of shapers and is protected by patent.

Machine for Straightening Work

Instead of straightening shafting or bars in the lathe the Rockford Drilling Machine Company, Rockford, Ill., are using



MACHINE FOR STRAIGHTENING WORK

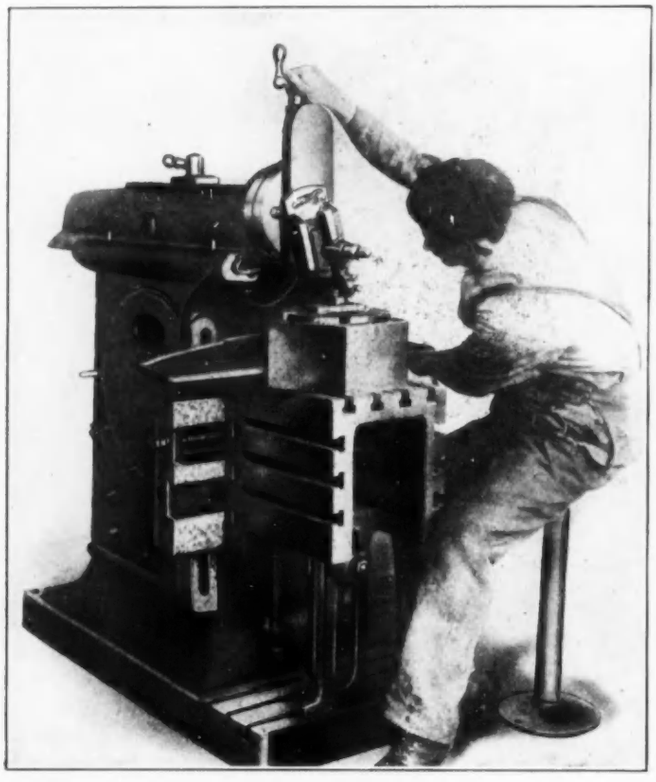


FIG. 1. THE USUAL WAY

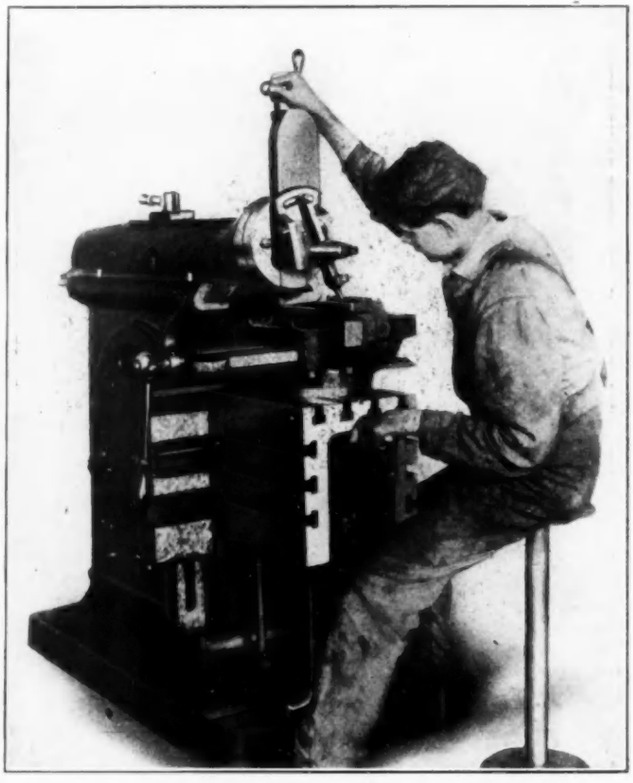


FIG. 2. WITH THE HANDLE IN FRONT

and building for the trade, the straightening machine shown in the accompanying illustration.

The head spindle revolves continuously, the work being driven by a leather faced collar which is held to the work by four coiled springs at the back. Support blocks are bored for each size work and from 1/16 to 3/32 inch below the spindle so that work will drop into them when released from the centers.

With the centers in place the work is revolved and the high spots marked, then the tail spindle is withdrawn, the work dropped on the supports and the screw brought over the high spot, after which the straightening is performed in the usual manner. It ought to save time and lathes in many shops as it takes in 8 feet between centers. The ratchet lever above the wheel can be swung into place for heavy work.

A Pin Universal Joint

The accompanying half-tone illustration Fig. 1 shows an universal joint which is both strong and simple. The details of its construction can be seen by referring to Fig. 2. It is composed of two yokes, one plate, four pins and an outer ring. All of these parts can be assembled and disassembled without the use of tools, as there are no screws or bolts in the construction. As the yokes are held by the plate in a manner which reinforces them it is impossible for them to spread. The outer ring holds the pins in position, and is itself held in place by two shouldered steel spring plugs which also provide means for oiling. In the center of the joint is a chamber which holds a quantity of oil. From this chamber the oil is fed through a hole in each pin connecting with outlets to all of the bearings so as to provide effective lubrication. All of the working parts are hardened steel to assure the quality of durability. The yokes themselves are made of drop forgings. While this joint was originally developed for automobiles, it is of equal service in connection with machine tools and for machinery in general. It is manufactured by the Kinsler-Bennett Company, Hartford, Conn.

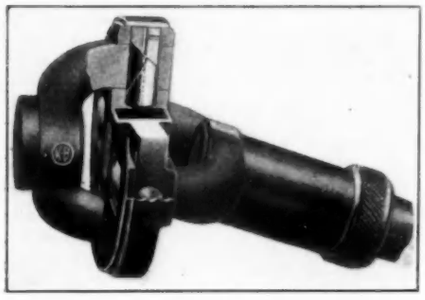


FIG. 1. A PIN UNIVERSAL JOINT

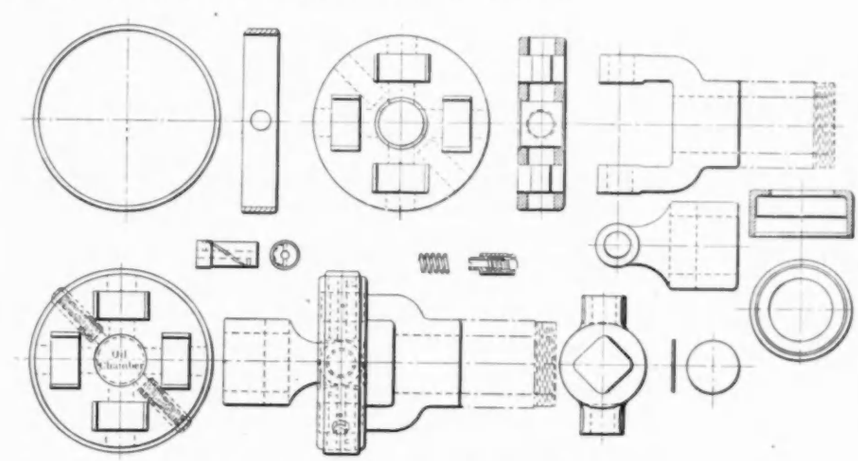
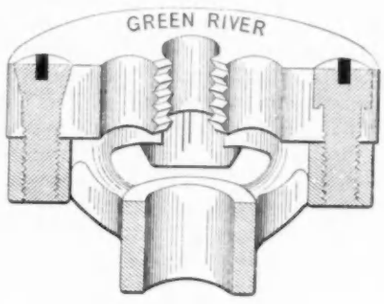


FIG. 2. DETAILS OF THE PIN UNIVERSAL JOINT

A Screw Plate for Brass Tubing

The Wiley & Russell Manufacturing Company, of Greenfield, Mass., have just brought out an improved guide, to be used with their regular dies and screw plate, for threading drawn brass tubing. The illustration shows the die and guide in section. The die is secured to the guide as in their usual line of screw plates, i.e., by one binding screw and by one tapered adjusting screw. The guide being long keeps the stock in line so that a straight thread may be cut and ample clearance allowed between it and the die so that the chips may readily fall and not jam and choke the die.



A NEW SCREW PLATE

Clearing up an Old Plant

By B. H. Spencer

One of the duties of each change of management in a plant is the necessity of clearing up and disposing of a quantity of obsolete and useless articles which have accumulated during previous years. The magnitude of the task before the organizer of new methods in a very old plant is often astonishing. It seems impossible for the previous executives to take to themselves the necessary courage to scrap the various articles whose usefulness had passed, and to face once for all the loss which had already occurred. Some of the articles which will be found lying around the plant in all sorts of places are obviously worthless and will be thrown in the scrap pile without hesitation. Others are parts of machines and may or may not become useful at some future time.

It is difficult for a new man to discover which of these articles have possibilities; which have been rendered obsolete and worthless by improvements producing better articles in their places; or which have been spoiled in manufacture and left around in the hope that in some way another misfit or some accident may render one or more of them useful. Other things have been made up for experiment and found unsatisfactory, or constructed on order and held because of failure to pay for the work, or have been taken in trade. All of these are very remotely connected with the possibility of income from their sale.

It is necessary to keep firmly in mind the fact that capital tied up in unnecessary stock is losing an earning power equal to the earnings of the capital stock of the concern, or at least equal to 6 per cent., if that is the current rate of interest. To retain a perfectly good article for one year is therefore equivalent to selling it today at a discount of 6 per cent., or whatever greater figure is proper, from its present-day value. This principle may be affected more or less by probable market changes. In the case of articles which cannot be fairly expected to go into use within two or three years, the probable loss is very heavy; the advantage is greatly in favor of promptly turning them into cash for what they will bring and replacing them if necessary by more modern articles. Even with more or less staple goods a big over-stock is objectionable, and where more or less depreciation has occurred from rust or abuse in handling so that articles will not bring full price it is well to remember that it is always possible to buy damaged goods cheap, if one wants them, while to sell them is a much more difficult matter.

The moral effect on the working force of a floor littered with unnecessary arti-

cles is bad, aside from the actual loss of time and loss by inconvenience in working over and around these useless articles. If it is proposed to sell the works it is probable that the plant will actually bring more with the floors clean and nothing in sight but standard marketable supplies than with an accumulation of odds and ends of all sorts, giving the impression that the management has been bad and that the concern is loaded up with unsalable articles. By all means when opportunity affords clean up the shop, whitewash the corners, sweep the floor and start afresh with nothing in sight but the necessary materials for completing the current work.

Notes on Electric Driving

By P. E. Severance

The ever extending use of electricity in manufacturing, coupled with the growing interest which readers of the American Machinist appear to be taking in this vast subject, prompts me to believe that a few notes based on a considerable experience may be acceptable to those who are on the lookout for economies in their driving arrangements.

The machine-shop owner who is isolated from outside sources of supply will be well justified in seeking expert advice when laying down a complete plant of generators, motors and accessories. But in the case of a shop situated in a district already served by power companies, where motors only are required, expert assistance would prove comparatively costly and, in view of the engineering salesmen who are capable and ever ready to give advice, it is quite unnecessary. However, as no two of them are likely to tender just the same advice, the poor non-electrical machinist is likely to come to the conclusion that striking the right system out of the dozen offered is like taking too big a risk.

It is, of course, needless to say that the cheapest-priced motor may not prove cheapest in the long run; incidentally neither may the dearest. The existing systems of supply are numerous, but as a consumer in a given district rarely has any choice in the matter, all one can do is to keep a sharp eye on the type and design of the motors and accessories he proposes to install. Broadly speaking, motors are made in two styles; viz., open and inclosed. Between these two limits there is a wide range of choice and the exact type installed should be controlled by the liability of the motor to injury from dampness, dust and mechanical damage.

The question of price is unfortunately too often allowed to influence the final choice, with the result that electrical driving is unjustly condemned. In order to fully understand just why the price should vary with the type, it is necessary to remember that an electric motor transforms electrical energy into mechanical energy. In this, as in all transformations of energy, a certain loss is entailed in the form of heat. If no provision was made for getting rid of this heat the motor would eventually get so hot as to break down or burn the insulation, with permanent damage to the machine and, of course, a complete shut-down. The efficiency of, say, a 10-horse-power motor, if well designed, will average about 88 per cent. That is, the input in the form of electrical energy must be,

$$\frac{100 \times 10}{88} = 11.36 \text{ horse-power.}$$

Consequently, when the motor is working at full load 1.36 horse-power must be got rid continuously in the form of heat. The radiating surfaces of the various parts must be proportioned to do this without reaching a temperature of more than 150 degrees Fahrenheit, which is considered the safe limit for continuous working.

In comparing an open-type machine with a totally inclosed one it will be noted that in the former all the various parts are accessible to the outside air; it has a large total radiating surface; whereas the latter must radiate all its heat from the surface of the inclosing case. In order to restrict the temperature to the limit given above, it is necessary either to make the case much larger or to cut down the losses. As cutting down the losses entails a larger case it is easy to see that a totally inclosed motor need not have a case with a radiating surface equal to the sum of the surfaces of the open type, but something smaller than that, the difference being offset by the decrease in the heat to be radiated or, in other words, by the improved efficiency of the machine. It will now be clear why the difference in price between a dust-proof or gas-tight motor and an open type one is so much more than would be accounted for by the necessary doors or lids over the openings. It will also be clear why buying an open-type motor and inclosing it in a wooden or sheet-iron box has so often led to disaster through overheating.

In the case of heavy machine shops, or for individual drives where the motor may be placed out of the way of flying chips and metallic dust, an open-type motor may be permissible and in many cases quite suitable. For wood-working or light machine shops, where there is sure to be an amount of wood or metal dust flying about, a totally inclosed machine will be found to be a good investment in the end. Assuming that the latter type is chosen, a design in which the doors are easily fixed or removed is to be preferred. The openings should be as large as possible in order to facilitate inspection and minor adjustments. For fixing the covers small screws and nuts are to be avoided in favor of wing nuts of reasonable size.

While it is true that a motor may be placed anywhere, yet a little forethought in choosing the exact position is needful. In the event of repairs it is a great advantage to be able to withdraw the armature easily, without further damage. In any case a machine which lends itself to easy inspection stands a better chance of getting that stitch in time which is said to save eventually nine.

All modern motors are fitted with ring lubrication. While they will in many cases run for months without attention, each one should be looked over once a week, although no adjustment or skilled attention should be necessary beyond adding a few drops of oil. Every three months the oil boxes should be thoroughly emptied and rinsed out with turpentine, in order to remove thickened oil, after which only fresh oil should be used to refill. A small but important point is that the oil-well covers should be self-closing; strange to say, many makers do not seem to fully appreciate this and many stoppages have occurred due to dust clogging the oil-rings, resulting in a badly scored shaft.

Using Helical Springs

By A. Jackson

An experience of four years in making helical springs has brought up many problems that could have been avoided by applying the proverbial "stitch in time saves nine" on the part of the designers. Many times a helical spring plays a very important part in high-grade machinery, and possibly a few hints as to what should be avoided may not be amiss.

Helical springs tapering in diameter of coil are not given to long life under high-speed work, as the coils of larger diameter deflect more easily than those of the smaller diameters and therefore do all the work, crystallizing in a comparatively short time. The same may be said of double-tapered or barrel-shaped springs. I have seen these so designed that all the work fell upon 4 coils when the total number was 16. Had large enough valve seats been provided for in the first place, a straight helix could have been used, allowing for an even distribution of the work which would reduce the chance of crystallization to a minimum.

In designing straight helical springs a good rule is to design such a spring as will have the greatest developed length of wire possible, using a narrow pitch.

Kent's "Hand-book" gives the most accurate formula for helical springs that I have ever seen. Most spring wire has a modulus of torsional elasticity of 12,000,000; figured on this basis, a spring may be designed very close to any required resistance.

In places where great resistance is required to work over a long distance and only a small diameter space is given, it is better to design a double spring (two separate springs, one within the other) than a sluggish spring of heavy wire.

Taken in general, a helical spring is a very common affair until it breaks; then, of course, it is all up to the springmaker, when in reality a disregard of the foregoing facts way back in the drafting room was at the bottom of the trouble.

Business Items

The Jacobson Machine Mfg. Co., Warren, Pa., has established a branch office at 676 Marietta Street, Atlanta, Ga., in charge of C. R. Morrison.

The George Nash Company, New York and Chicago, has removed its Chicago office and warehouse from 24 S. Clinton Street to its large new building at 115 Washington boulevard.

Trade Catalogs

Brown & Sharpe Mfg. Company, Providence, R. I. Booklet describing constant speed drive milling machine. Illustrated, 12 pages, 4½x6½ inches, paper.

Goldschmidt Thermit Company, 90 West street, New York. Pamphlet containing shop instructions for the use of Thermit in repair work. Illustrated, 32 pages, 5x8 inches, cloth.

Weber Gas Engine Company, Kansas City, Mo. Brochure No. 56, entitled "Governors That Govern" which tells about the Weber gas engine driving an electric generator. Illustrated, 4 pages, 4x9 inches.

General Electric Company, Schenectady, N. Y. Catalog of electric fan motors. Illustrated, 24 pages, 8x10½ inches, paper. Bulletin No. 4548, showing application of small motors to machine tools. Illustrated, 24 pages, 8x10½ inches.

Manufacturers

S. B. Foot & Company, Red Wing, Minn., will erect a new tannery.

The Hagerstown (Md.) Foundry Company contemplates erecting a new plant.

The Standard Bridge Company, Omaha, Neb., will erect a $25,000 factory at Red Oak, Iowa.

The Gadsden (Ala.) Pipe and Fittings Company will install machinery for manufacturing stoves.

It is reported that the Westport (Conn.) Paper Company will probably rebuild plant recently burned.

The Cape Fear Lumber Company, Wilmington, N. C., will rebuild mill recently destroyed by fire at a loss of $100,000.

Plans have been completed for a machine shop for gasolene engines for the J. Lawson Mfg. Co., New Holstein, Wis.

Plans are being prepared for a casting building and a separating machinery building for the Eagle White Lead Company, Cincinnati, Ohio.

A four-story factory is being erected for the James Morrison Brass Mfg. Company, Toronto, Ont., which will cost about $60,000.

The California Corrugated Culvert Company is planning to erect a plant in West Berkeley, Cal., at a cost of $10,000.

B. S. Ellis, Fork, S. C., contemplates establishing a woodworking plant for making bannister posts, column posts, etc.

The Northwestern Building Company of Dickinson, N. D., will erect a factory in Miles City, Mont. for making sash, doors and moldings.

The Woodstock Foundry Company, incorporated with $500,000 capital, will erect a plant in Anniston, Ala. J. M. Barr of Anniston is president.

The Campbell Manufacturing Company, Gadsden, Ala., has been organized with $50,000 capital to manufacture pipe fittings and plumbing supplies. Otto Agricola, president.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry and Parker, Erie, Pa.

Draftsmen office agents wanted for new style tools. D. J. Kelsey, New Haven, Conn.

We buy or pay royalty for good patented machine or tool. Box 282, AMERICAN MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

New English patent act; manufacturing firm, equipped with modern plant, is prepared to negotiate with foreign holders of English patents with a view to undertaking their manufacture; preferably machine tools. Address Box 882, AMERICAN MACHINIST.

Special machinery designed and built; duplicate parts, tools, jigs and dies. The Wade Machine Co., 133 Oliver St., Boston.

Special machinery accurately built. Screw machine and turret lathe work solicited. Rouert J. Emory & Co., Newark, N. J.

Special machines designed and built; duplicate parts, model or experimental work. Mantle, Park Ave. and 129th St., New York.

Engineering firm with able staff desires drafting or designing work of any kind. Reasonable charges. Box 918, AMERICAN MACHINIST.

Inventions, novelties, ideas, etc., developed; special machines designed. Albert Pott, M. E., 23 Platt St., New York, and Waterbury, Conn.

If you have a copy of March 7, 1907 AMERICAN MACHINIST we'll give you fifteen cents for it AMERICAN MACHINIST, 505 Pearl St., New York.

Wanted—Some novelty or small machine to manufacture. Will buy patent, or territory rights. Capital Foundry & Machine Co., Frankfort, Ky.

Wanted—Exclusive sales agency for New York territory for some standard machine, tool, steam, or electrical specialty. Box 868, AMERICAN MACHINIST.

Gears cut to order, bevel spur and mitre, on Bilgram and Gleason machines. Complete gears furnished. The Cincinnati Gear Works, Murdock Building, Cincinnati, Ohio.

Lathe and machine work of every description patterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric and Machine Co., Paterson, N. J.

Wanted—Parties in need of capital to carry on their business. I can offer you substantial financial assistance if you have anything offering good returns. Box 908, AMERICAN MACHINIST.

Wanted—A copy of Volume 9 of the Transactions of the American Society of Mechanical Engineers, date 1887 and 1888. Address, Box 29, Providence, R. I., stating price and condition of volume.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy, and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

New British patent laws; high class engineering firm with modern plant is open to quote favorable terms for building engineering specialties or machine tools in England. The Simplex Engineering Co., Ltd., Trafford Park, Manchester.

Wanted—By a man of manufacturing and technical experience, willing to furnish some capital, a patented machine or device or other good manufacturing proposition, sharing good possibilities; able to manufacture and sell to good advantage. Box 883, AMERICAN MACHINIST.

Competent business man and engineer owning patterns and drawings of full line of high class well known machinery, on market for fifteen years, desires to connect with first class modern shop to manufacture and market same with services of advertiser. Judicious advertising and modern selling methods will yield business of $75,000 to $100,000 per year or more. Address Box 902, care AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Designer wishes to make a change; 6 years experience in automatic tool machinery, jigs, fixtures and tools; any location satisfactory, Box 907, AMERICAN MACHINIST.

INDIANA

Situation Wanted—By capable man, to take charge of mechanical department of firm building fine and accurate machinery and devices. Has many years experience in systematizing and establishing standards on the interchangeable plan. Has held responsible position. Can handle men. References. Address M. M., AMERICAN MACHINIST.

MASSACHUSETTS

Wanted supervision by an active expert mechanic, a genuine cost reducer, productive and up-to-date organizer and systematizer. Address "Systematizer," AMER. MACHINIST.

MISSOURI

General foreman of large auto manufactory; twenty years of practical and executive experience on medium manufactures and interchangeable parts. Thoroughly up-to-date on modern shop practice and system; expert on tool and special machine design. Capable of handling large force of skilled or unskilled men. Desire immediate change. Reasonable salary; A1 reference. Box 904, AMERICAN MACHINIST.

NEW JERSEY

Foreman, lathe specialist, wishes to change position for big factory, age 35. Box 901, AMERICAN MACHINIST.

Draftsman, graduate mechanical engineer, 3 years shop and designing experience on gas and steam engines and air compressors; location anywhere. Box 914, AMERICAN MACHINIST.

Mechanical draftsman wishes position, 8 years' experience designing special and automatic machines; can invest money with services. Address "Engineer," Box 922, AMERICAN MACH.

Engineer, superintendent, chief draftsman desiring change, specialist in coal and ore handling, elevating and conveying machinery, traveling cranes and industrial railway design, construction and erection, successful in handling labor. Box 920, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wishes position. Box 926, AMERICAN MACHINIST.

Instrument and tool maker wishes position anywhere (22). Box 916, AMER. MACHINIST.

Mechanical draftsman, 25, wants position. New York preferred. Box 915, AM. MACHINIST.

Wanted—A position as chief engineer, mechanical and electrical; can furnish the best of references by inquiries. Box 183, AMERICAN MACH.

Designer, broad experience in fixtures and automatic tools for light and medium work. A-1 references, terms moderate. Box 919, AM. MACH.

Wanted—Position as foreman-japanner, 11 years' experience. An expert on finishing all kinds of metal work. Box 911, AM. MACHINIST.

Assistant superintendent or general foreman; a producer familiar with modern organization, shop systems and tool design, desires position. Box 903, AMERICAN MACHINIST.

Student I. C. S. (mechanical drawing course just completed) wishes position at detailing or tracing, high school graduate, one year machine shop and foundry. Age 20, references, location anywhere. Box 923, AMERICAN MACHINIST.

Practical electrician, 15 years' experience in all details of electrical maintenance, familiar

with cranes, desires a position in some large machine shop or manufacturing plant. Married man, age 37. Box 917, AMERICAN MACHINIST.

Wanted—Position by foundry foreman; young, strictly temperate in habits, well up in cupola practice and mixing iron and brass; thoroughly understands equipping and organizing new foundries; can furnish best of references; willing to go anywhere. Box 881, AMERICAN MACHINIST.

OHIO

Mechanical engineer, 28, college graduate, 8 years' shop and drawing-room, wants to change. Good executive ability, A-1 designer. Box 913, AMERICAN MACHINIST.

All around machinist, mechanical draftsman, last employed on repairs to machine tools, and general machinery in steel plant, wants position. Box 912, AMERICAN MACHINIST.

PENNSYLVANIA

Position as foreman machinist by experienced tool maker familiar with modern shop methods and handling men. Good reference. Box 924, AMERICAN MACHINIST.

Draftsman, college graduate with good experience in hoisting and conveying machinery, cranes, charging machines and structural work, desires position. Box 921, AM. MACHINIST.

WISCONSIN

Wanted position by superintendent desiring a change, age 40, perfect health, technical, practical, wide experience gas engines, producer engines, steam pumps, tool building, special and automatic machinery, large and small stamping die work, and foundry practice. Fourteen years' shop practice, 10 years' factory executive, advertiser's forte is putting old and new plants in shape to produce a maximum of high grade work at a minimum direct and indirect cost, based on modern methods. Can produce exhibits of earning power. I will contract to produce given results. Position requiring broad gauge man desired (go anywhere). Box 925, AMERICAN MACHINIST.

FOREIGN

Master mechanis; American; age 37; responsible man with large and varied experience manufacturing, erecting and maintaining; successful in producing high grade work at lowest cost; at liberty July 1; Pacific Coast States only; state salary. B. Nillus, Master Mechanic, Rio Blanco, Peru, via Lima.

Help Wanted

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS

Wanted—First-class foreman for machine work on brass castings; also foreman for machine shop on general and small work. Box 872, AMERICAN MACHINIST.

MICHIGAN

Wanted—An assistant general manager, in an established machine shop manufacturing marine engines and mill machinery. One having selling and manufacturing experience preferred. Full particulars and photograph requested. Box 909, AMERICAN MACH.

MINNESOTA

Wanted—A first-class foreman for machine department; young, progressive man preferred. Must be good mechanic and hustler. Splendid opportunity in shop located in the Northwest. Box 889, AMERICAN MACHINIST.

NEW YORK

Wanted—A few first-class machine hands (no other need apply) for night work for boring mill, planer, and lathe on large engine work. Address, giving age and reference, P. O. Box 953, Buffalo, N. Y.

OHIO

Premium work system man. Must be mechanic and competent to fix rate of piece production and make system a success. Box 890, AMERICAN MACHINIST.

Foreman experienced on light machine work by large manufacturing company in central west. A man who has had charge of the making of controllers and similar small electrical apparatus is preferred. Give full particulars as to experience and wages expected. Box 905, AMER. MACHINIST.

WISCONSIN

Wanted—A young man of general shop and drafting-room experience, to design gas engines, producers and pumps. State experience in detail and give references. Box 910. AM. MACH.

For Sale

For Sale—Foundry, wood and iron machine shop; all equipped. Box 74, Albion, N. Y.

For Sale—Time registers, one 200 and two 100 number Dey dial machines in A-1 condition. Box 906, AMERICAN MACHINIST.

For Sale—The right to manufacture the best tilting tumbling barrel out; covered by a good strong patent. Box 895, AMERICAN MACHINIST.

For Sale—Well equipped general machine shop in New Jersey; employing 15 to 20 hands; good reason for selling. R., Box 1216, New York City.

Patents for sale; an inexpensive bevel and mitre gear cutting attachment for use with a shaper; will unquestionably do a class of work which has heretofore been possible only with very high priced special machines. Address, W. W Clippinger, 80 Atlas Bank Bldg., Cincinnati, Ohio.

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Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Aurora, Ill.

Box Tools, Roughing
Bardons & Oliver, Cleveland, O.

Brazing
Industrial Oxygen Co., New York.

Broaching Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine and Tool Co., Toledo, O.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum
See Grinding Wheels.

Carborundum Paper and Cloth
Carborundum Co., Niagara Falls, N. Y.

Case-Hardening
American Gas Furnace Co., New York.
Rogers & Hubbard Co., Middletown, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Cast Iron Brazing
Industrial Oxygen Co., New York.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.
Neptune Meter Co., Long Island City, N. Y.
Rowell Co., W. G., Bridgeport, Ct.

Castings, Die Molded
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cell Drier Machine Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Taylor & Fenn Co., Hartford, Ct.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cammel, Laird & Co., New York.
Carpenter Steel Co., Reading, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Krupp (Thos. Prosser & Son), New York.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
National Machine Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.

Chains, Driving—*Continued.*
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt Chuck Co, Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co, Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.

Circuit Breakers
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Hammacher, Schlemmer & Co., New York.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Starrett Co., L. S., Athol, Mass.
Tudor Mfg. Co., Taunton, Mass.
Williams & Co., J. H., Brooklyn, N. Y.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cowanesque Valley Iron Wks., Cowanesque, Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Compound, Core
Obermayer Co., S., Cincinnati, O.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Machinery Co., Bradford, Pa.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Blaisdell Machinery Co., Bradford, Pa.

Cones, Friction
Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Cambridge, Mass.
Cell Drier Machine Co., Taunton, Mass.
Dietz Machine Works, Phila., Pa.
Ingle Machine Co., Rochester, N. Y.
Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic
Lamson Consolidated Store Service Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum
See Grinding Wheels.

Cotters
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Machinery
Veeder Mfg. Co., Hartford, Ct.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Smith Countershaft Co., Boston, Mass.